

Get to know what you cannot see



FORCE Technology
Oil & Gas

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About FORCE Technology



- FORCE Technology is an:
- Independent, non-profit company.
- Development budget > DKK 120 million
- ~ 1200 Employees in 5 Countries
 - N: 140 / S: 150 / DK: 900

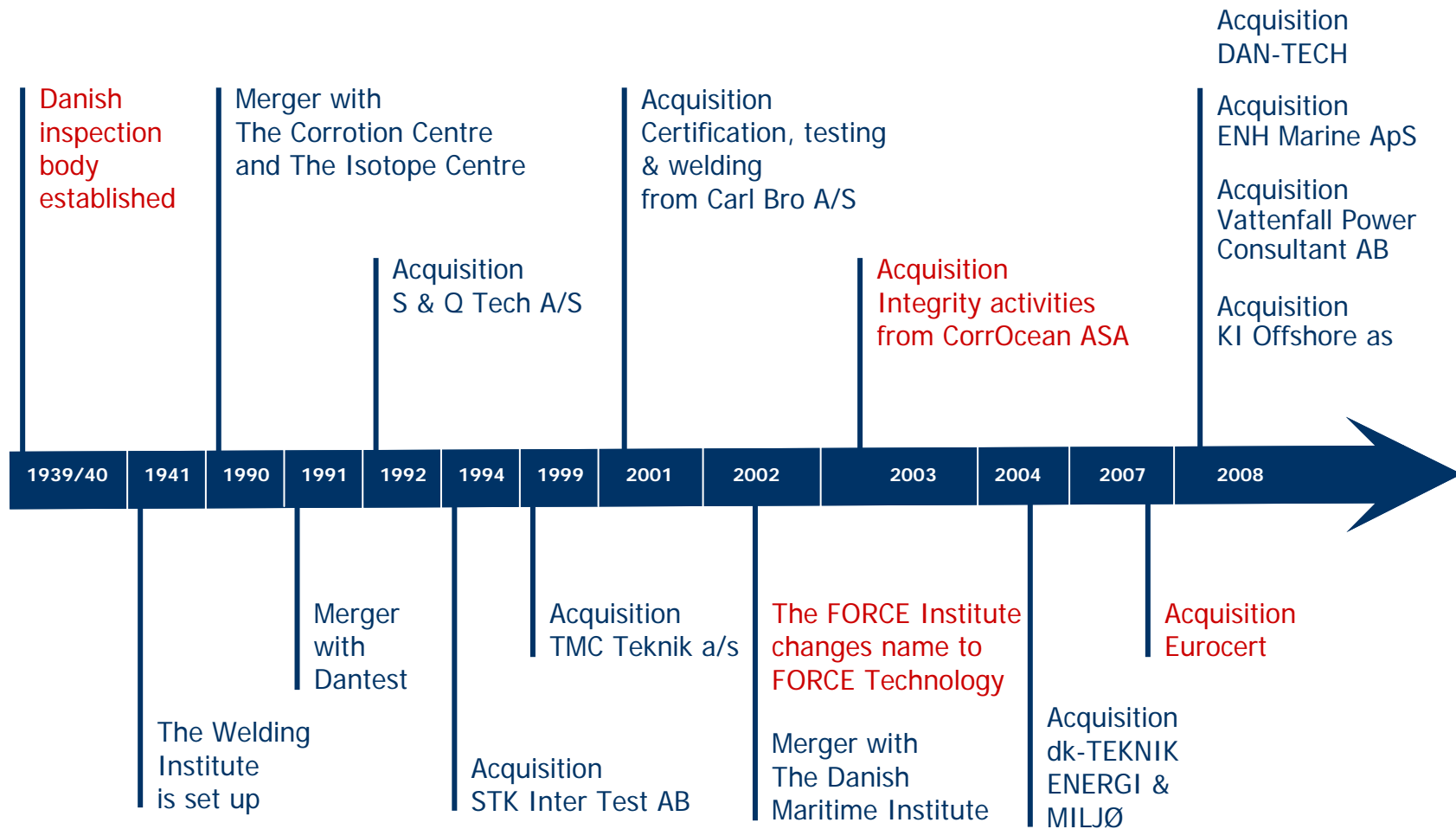
A multidisciplinary Organization with major capability in Northern Europe



GODKENDT
TEKNOLOGISK SERVICE



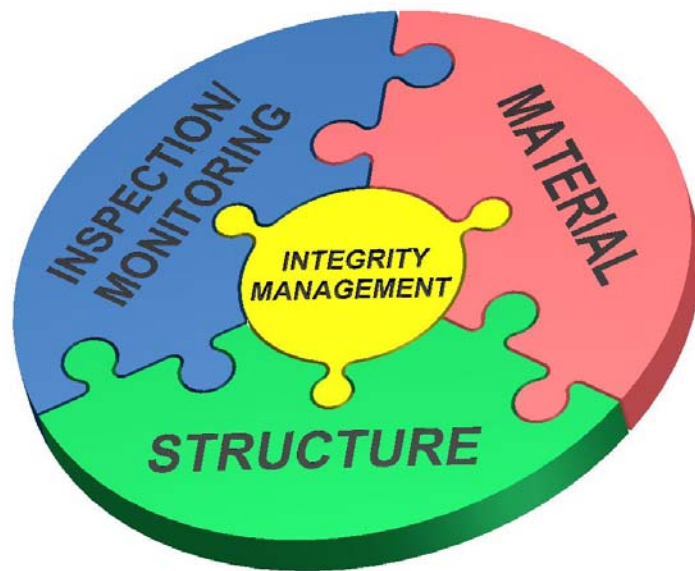
History



1982, Start Subsea NDT

1990, Start Subsea Monitoring

“We take care of values that create values”



25 000m² Lab facilities

Holistic approach on:

- Land based industry
- Power plants
- Refineries
- Topsides
- Riser and mooring
- Pipe lines
- Subsea

Materials Testing (Lab..)

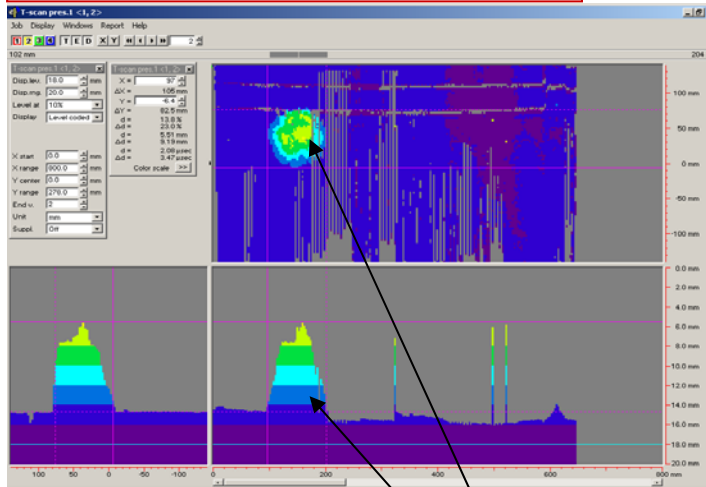


NDT Inspection on a FPSO Tank



Looking for internal corrosion. Proof of the pudding (topsides, same tool as used subsea)

Inspection with P-scan
FORCE Finding



4 months later
Customer Solving of
problem



Structure Engineering Services



Operational Structure: FORCE Technology Norway AS

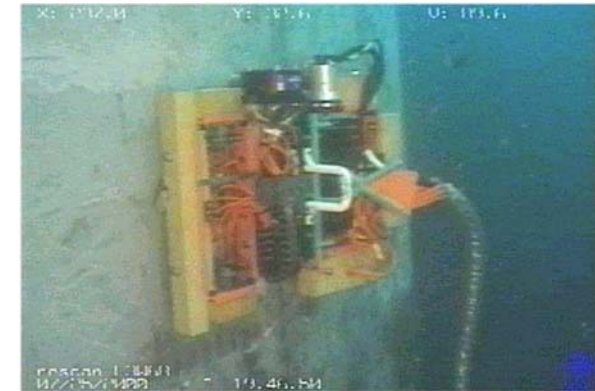


1. **Asset Integrity Management & Consulting Services**
 - Materials and Integrity Management
 - Pipeline Integrity Management
 - Risk Based Inspection (RBI)
 - Maintenance Management (RCM)
 - Data Management and Consulting Services
2. **Structural Integrity Services**
 - Design
 - Reassessment
 - Marine Engineering
 - Advanced Structural Analysis
3. **Inspection & Monitoring Services**
 - Inspection and Consulting Services
 - Advanced NDT Inspection (Subsea NDT Roscan)
 - Monitoring Services
 - Material Technology
4. **NDT Training and Certification**

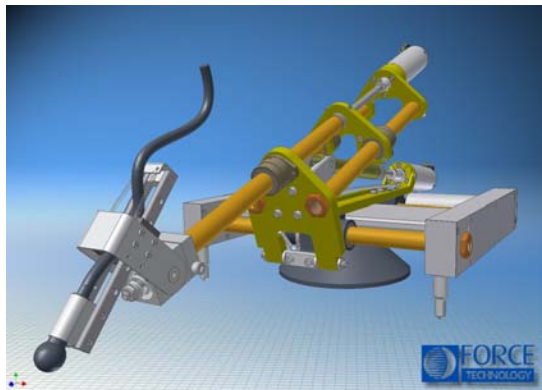
Some of our Subsea NDT inspections tools



- Using ROV or divers as the Taxi for getting access to the inspections points.
- Mounts directly to the structure, to get the best result of our inspection.
- Controlled remotely with the use of trained and certified experts.
- We store all our inspection Data for later use.

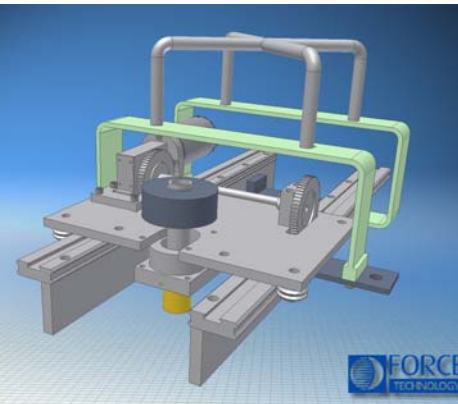
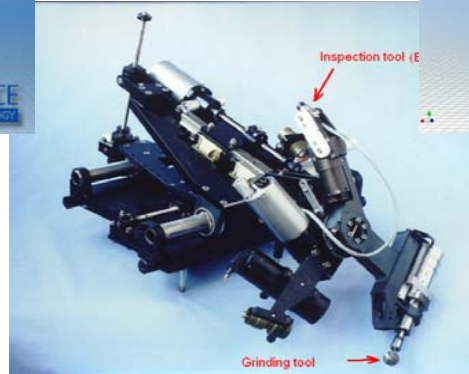


P-scan / AUS-4



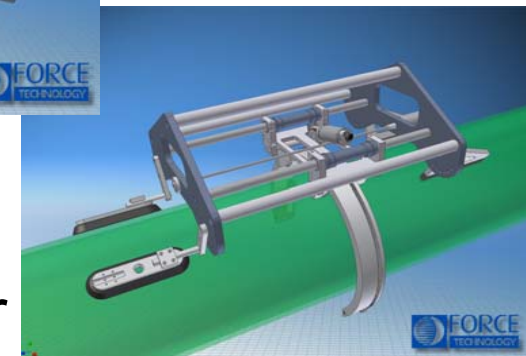
F-EIM tool

F-GRIM tool



Pipe Scanner

Water level measurement scanner:

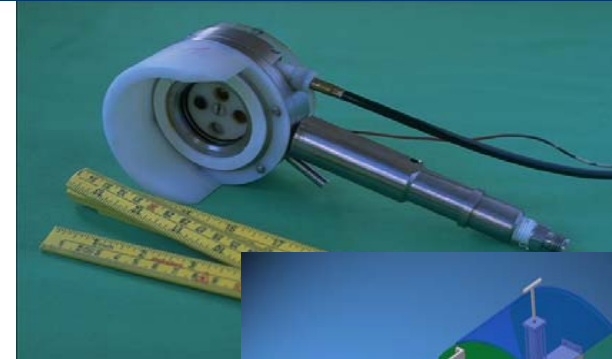


More Subsea Tools



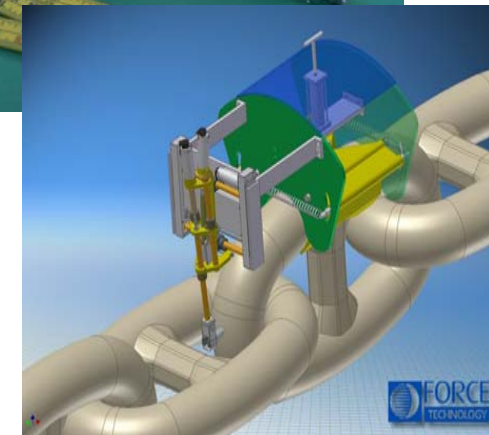
The F-Bolt Scanner tool:

The bolt scanner uses ultrasound to detect cracks in bolts in situ on a subsea construction, making retrieval unnecessary.



The F-Chain measure scanner:

For measuring chain wear. Can be done in situ. The system is based on ultrasonic technique.



Internal Armour Inspection (Flexible Pipes)

Internal: Carcass and hoop armour

Failure modes: unlocking, fatigue cracks

End fitting inspection

External: tension armour

Failure modes: fatigue cracks, corrosion

Repeated inspections = Monitoring

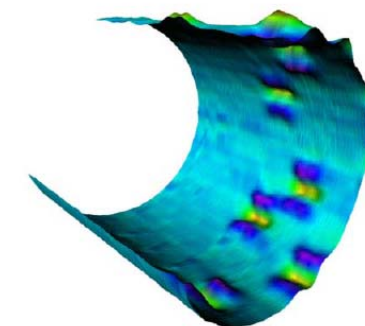


Figure 13: Isolation of Pressure Armour welding errors.

Structural integrity



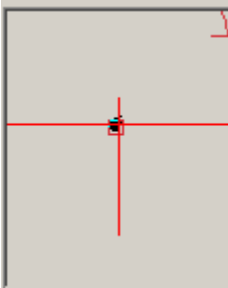
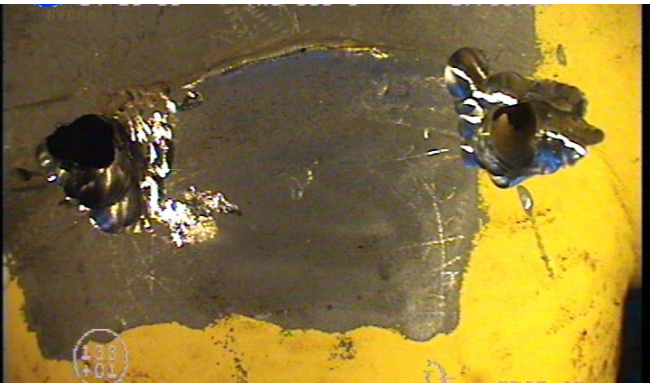
Can cracks be seen

full penetration?

Eddy current state of the art, 0.5*10 mm crack



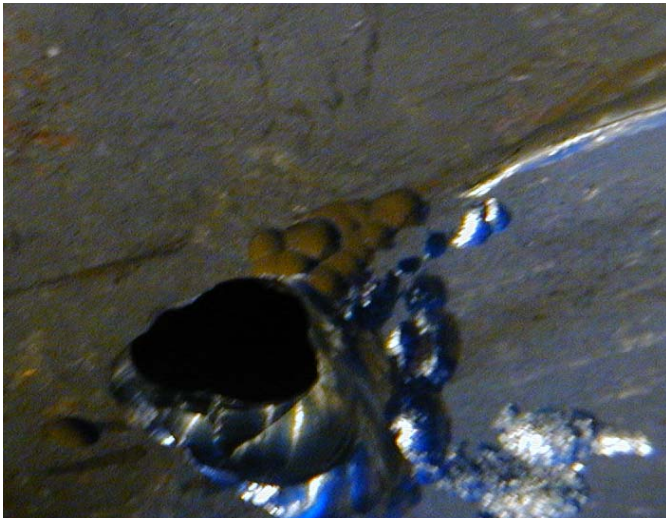
Crack on structural part



Normal signal



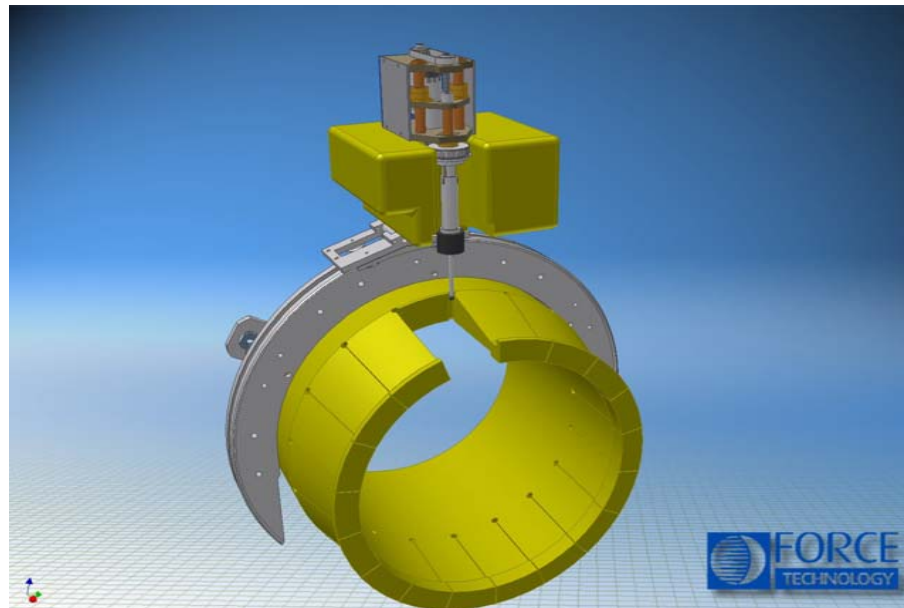
Crack signal



Trouble shouting



- Difficult geometries
- Difficult access
- Critical components

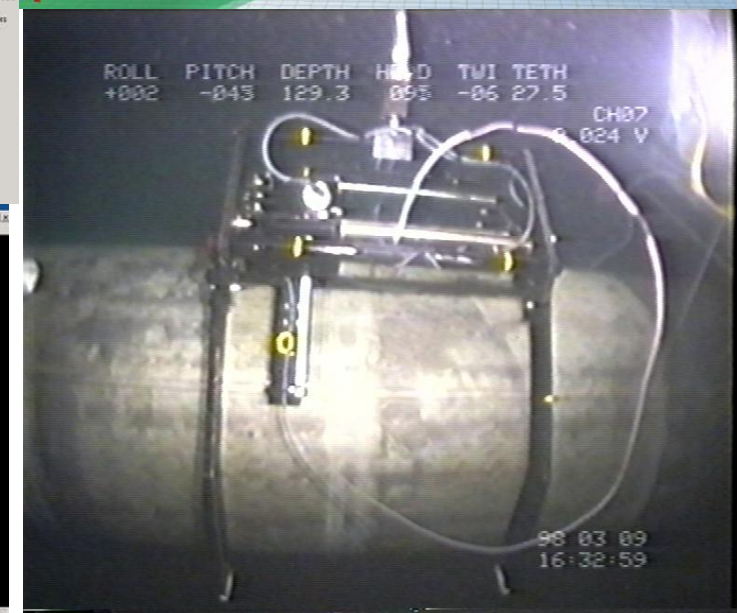
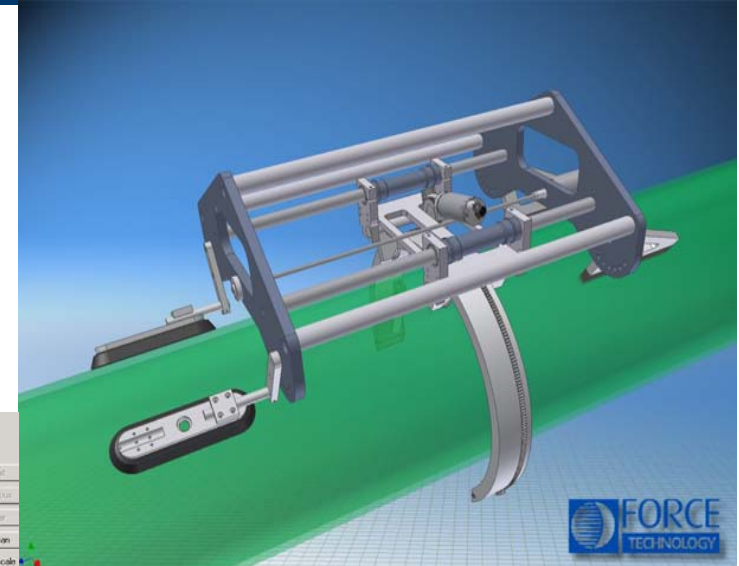
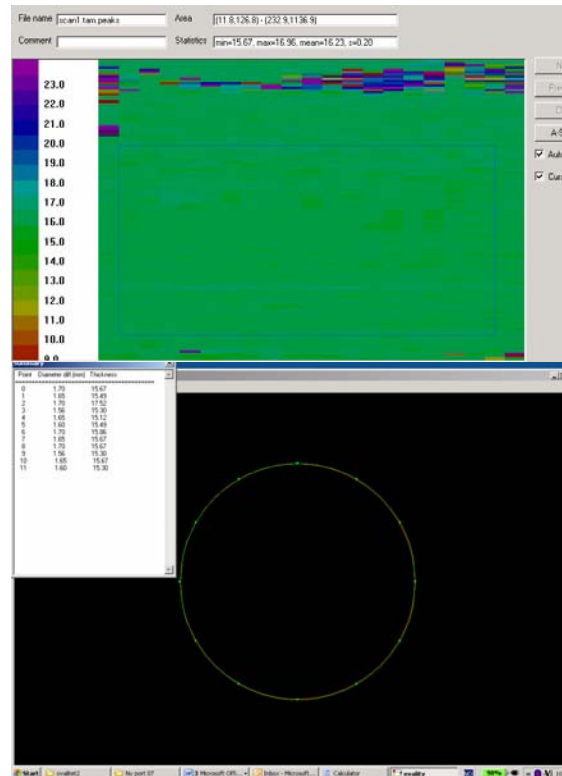


F-Pipe / Detailed pipe inspection

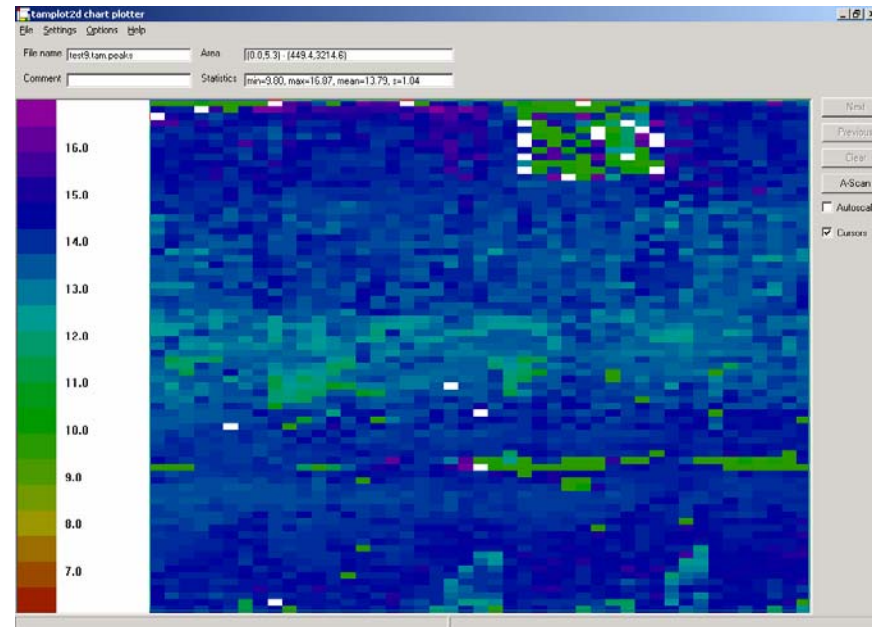
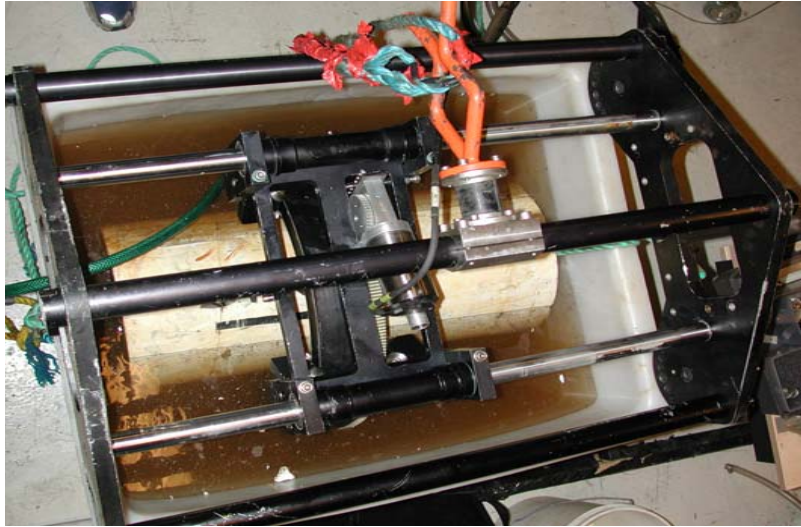


External Ultrasonic inspection

- Wall thickness
- Delamination
- Ovality



Internal corrosion

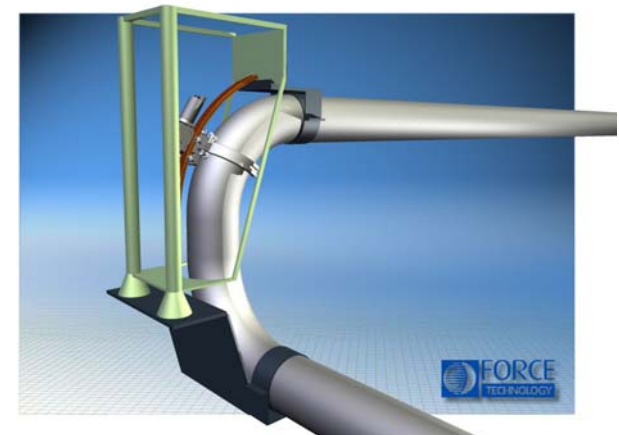
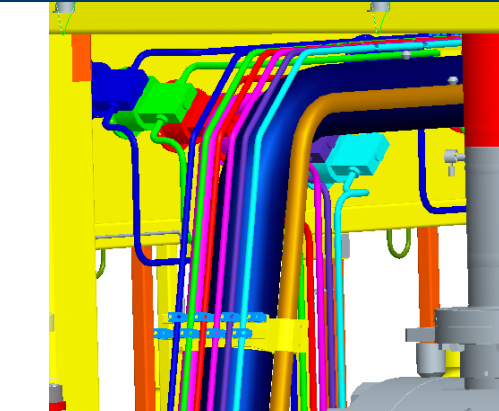
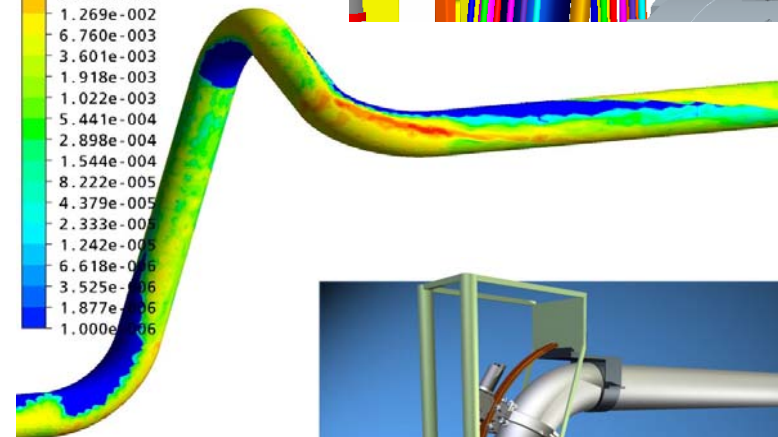
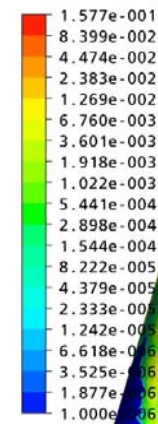


Erosion in a bend?



- Typical design-> no access
- Where do we measure
- What do we need to inspect?
- Combination of Model, design, baseline and tool-> Good position

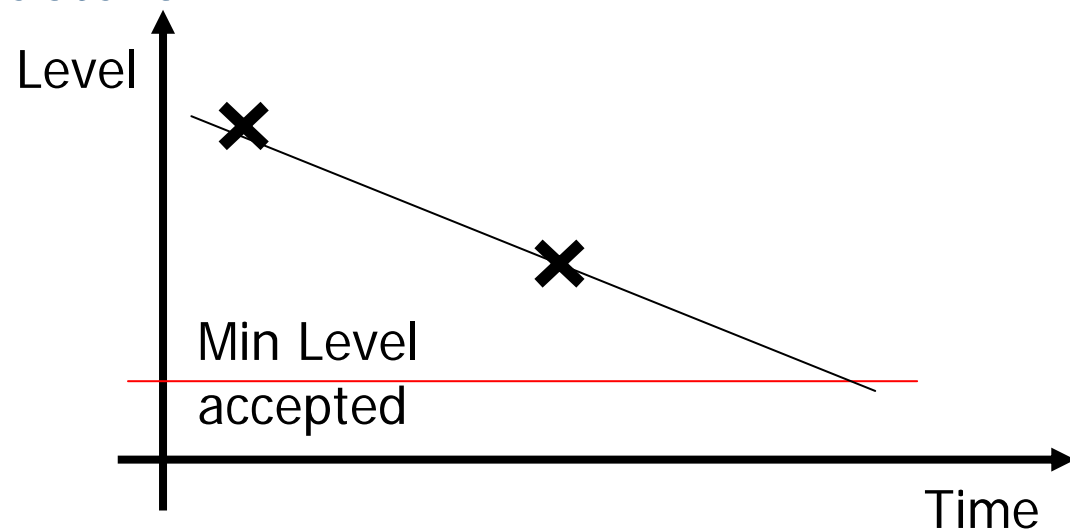
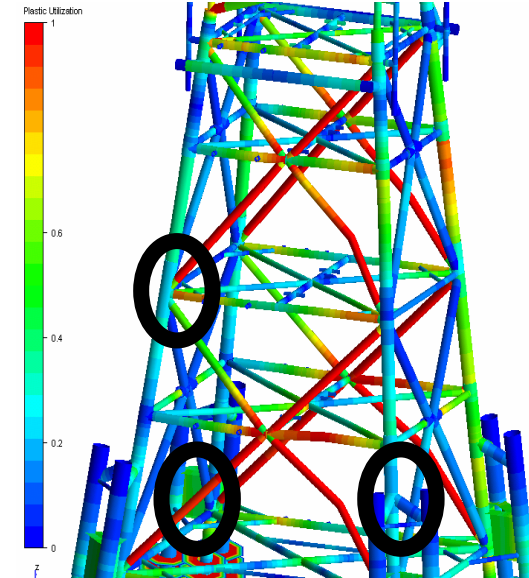
Erosion Rate [mm/year]



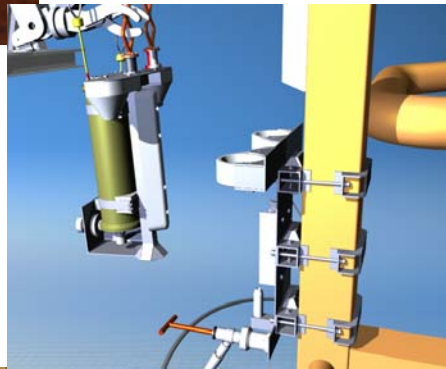
Risk Based Inspection (RBI)



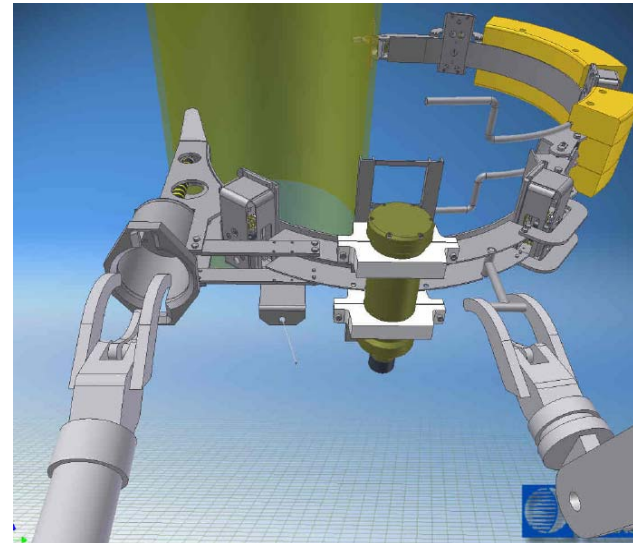
- You inspect critical points.
- With use of knowhow and experience, it is possible to focus on the high risk points on your Structure/main steel, and with the inspected data from these points, you know something about the integrity of the total structure.
- Comparing stored inspected data -> rate of change



Instrumentation of conductor



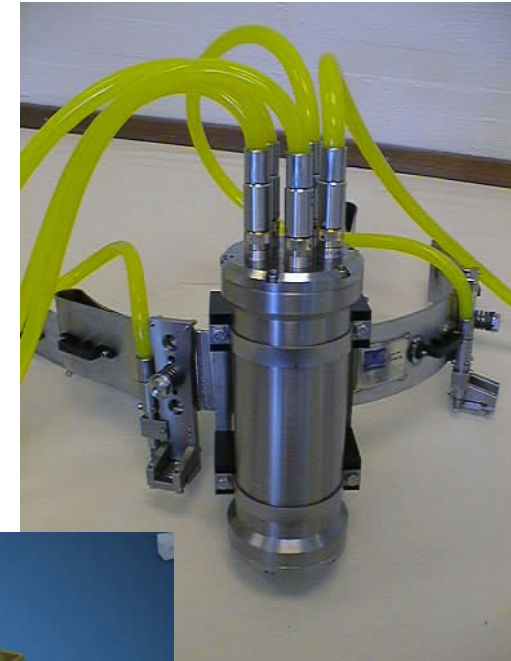
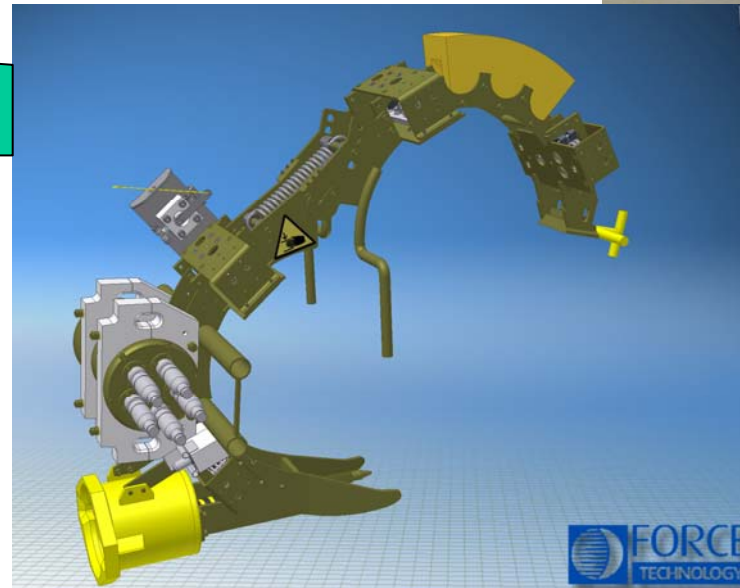
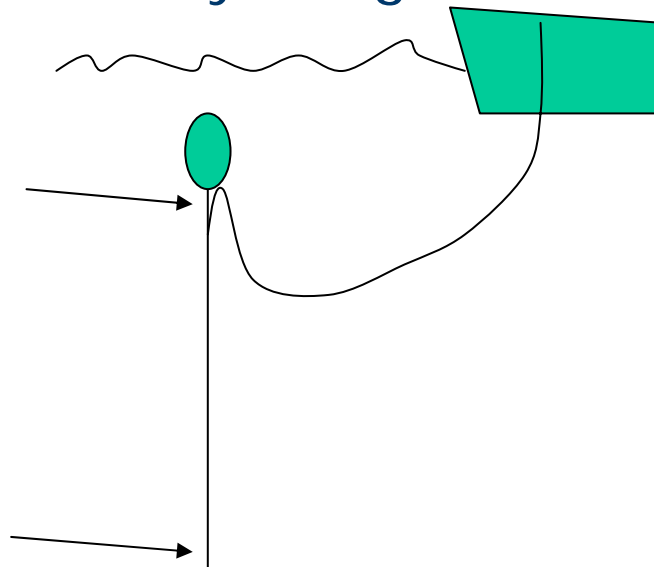
- Deep water
- Strain and movement
- Access
- Possibly part of a riser monitoring system



Riser tower buoyancy



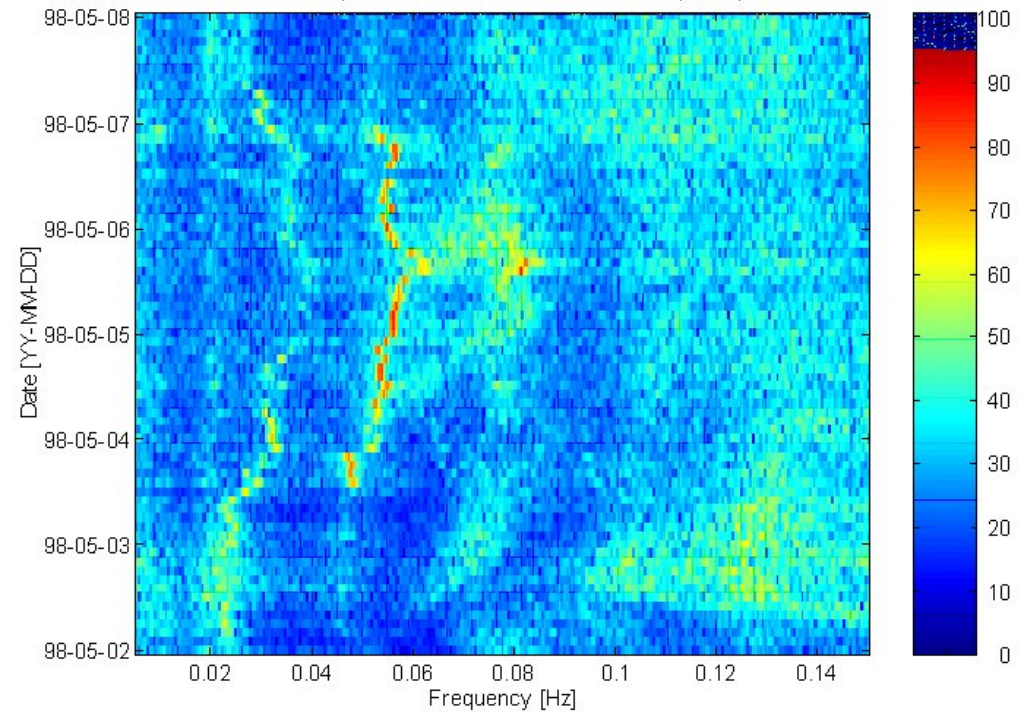
- Accurate strain measurements 10-20 μ range
- ROV installable and retrievable
- 25 y design life



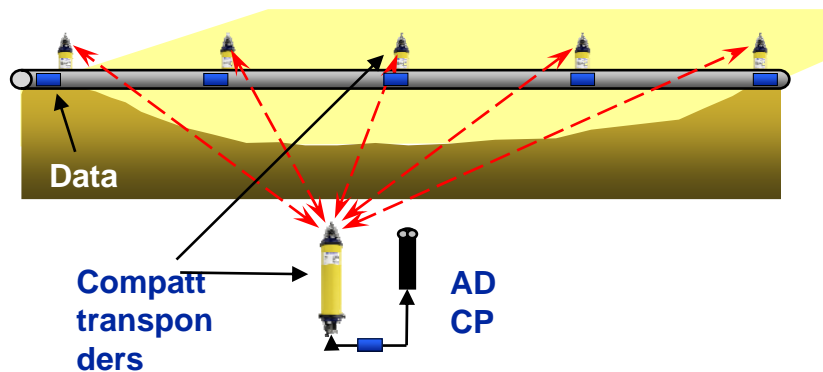
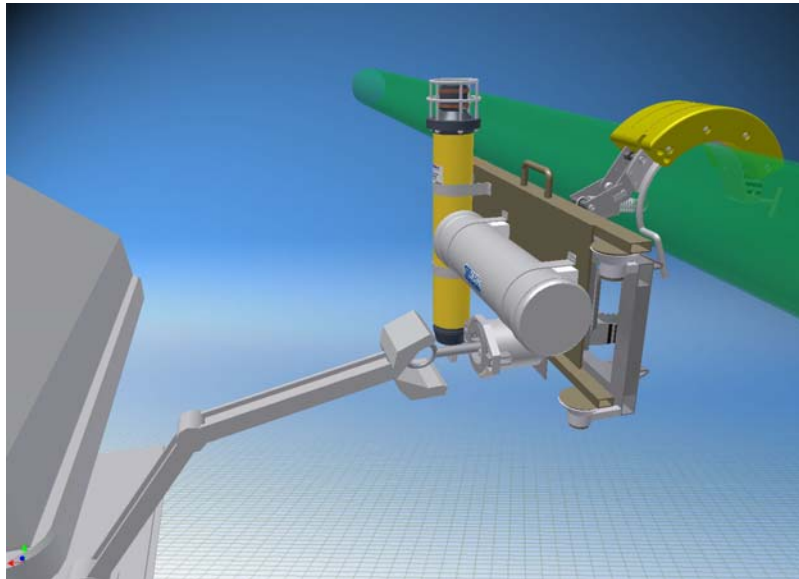
Tension risers, VIV



- ROV installable ERA sensors
- Autonomous
- Fly in and install



Pipeline free span, VIV



- DACOS flight recorder, 3 after 6 DOF, autonomous
- Synchronous to 0,1ms
- ROV clamps to pipe,
- Detachable logger unit
- Purpose
 - Measure vibrations
 - Measure movement/ displacement

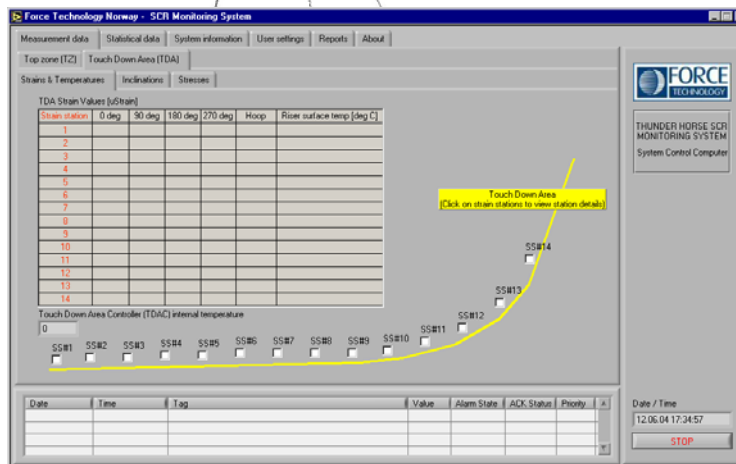
Instrumentation, SCR



- Hang off/flex joint and Touch down area
 - 5 Risers flexjoint
 - 1 riser at Touch Down Area
 - 174 points, 25 Hz

- Angle, curvature, strain
- 2000m depth, 25y service life

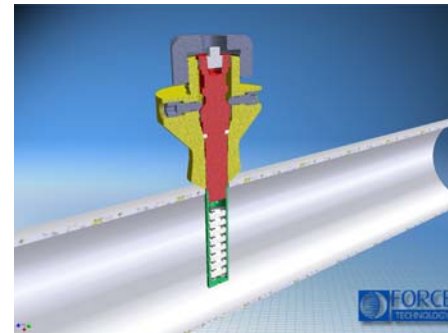
- Purpose
 - Confirm model
 - Actual fatigue damage



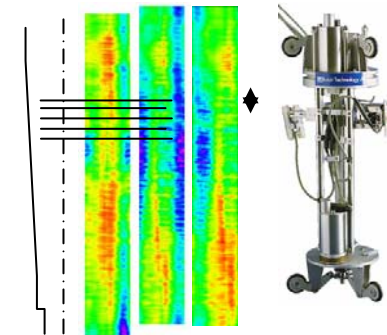
Flexible Pipe Integrity and Monitoring



- Flexible pipe monitoring
 - F-Polymer (Coupons)
 - F-VGM (vent gas)
- Flexible pipe Inspection
 - Carcass
 - Pressure armour
 - Tensile armour
- Flexible pipe integrity
 - Polymer analysis/prediction
 - F-DBM, Integrity database
 - F-FRIB, Inspection and monitoring strategy



F-Polymer



NDT Inspection



F-VGM

Exit													
River technical support project, Italian Nordland, The Argent field, A database made/operated by Coffevip-Stena Offshore Norge and Corrocean For Statoil													
Database File 2, Insect 03.02.2003	View field report See Report A, Insect conditions See Report B, Insect conditions												
<table border="1"> <tr> <th colspan="3">Temperature operational data</th> <th colspan="2">Pressure operational data</th> </tr> <tr> <td>Realtime temperature</td> <td>Time of temperature</td> <td>Temperature drop points</td> <td>Realtime pressure</td> <td>Time of pressure</td> </tr> </table>		Temperature operational data			Pressure operational data		Realtime temperature	Time of temperature	Temperature drop points	Realtime pressure	Time of pressure		
Temperature operational data			Pressure operational data										
Realtime temperature	Time of temperature	Temperature drop points	Realtime pressure	Time of pressure									
<table border="1"> <tr> <th colspan="4">Medium content operational data</th> </tr> <tr> <td>H2S Content measurement</td> <td>Produced water composition</td> <td>Produced water total sulphur composition</td> <td>Ammonia gas composition</td> </tr> </table>		Medium content operational data				H2S Content measurement	Produced water composition	Produced water total sulphur composition	Ammonia gas composition				
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<table border="1"> <tr> <th colspan="2">Polymer coupon results</th> <th colspan="2">Ammonia data</th> </tr> <tr> <td>Summary of polymer sterility</td> <td>Summary of polymer mechanical properties</td> <td>Summary of thermal stress coupons</td> <td>Ammonia gas vent volume measurement</td> </tr> <tr> <td></td> <td></td> <td>Ammonia gas vent volume measurement</td> <td>Ammonia free volume measurement</td> </tr> </table>		Polymer coupon results		Ammonia data		Summary of polymer sterility	Summary of polymer mechanical properties	Summary of thermal stress coupons	Ammonia gas vent volume measurement			Ammonia gas vent volume measurement	Ammonia free volume measurement
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<table border="1"> <tr> <th>Structural data</th> <th>Historical findings/events</th> </tr> <tr> <td>Correlation between pipe ID and pipe version</td> <td>Historical findings/events</td> </tr> </table>		Structural data	Historical findings/events	Correlation between pipe ID and pipe version	Historical findings/events								
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Correlation between pipe ID and pipe version	Historical findings/events												
DATABASE FILE													

PIM database

Summary / The best way of knowing

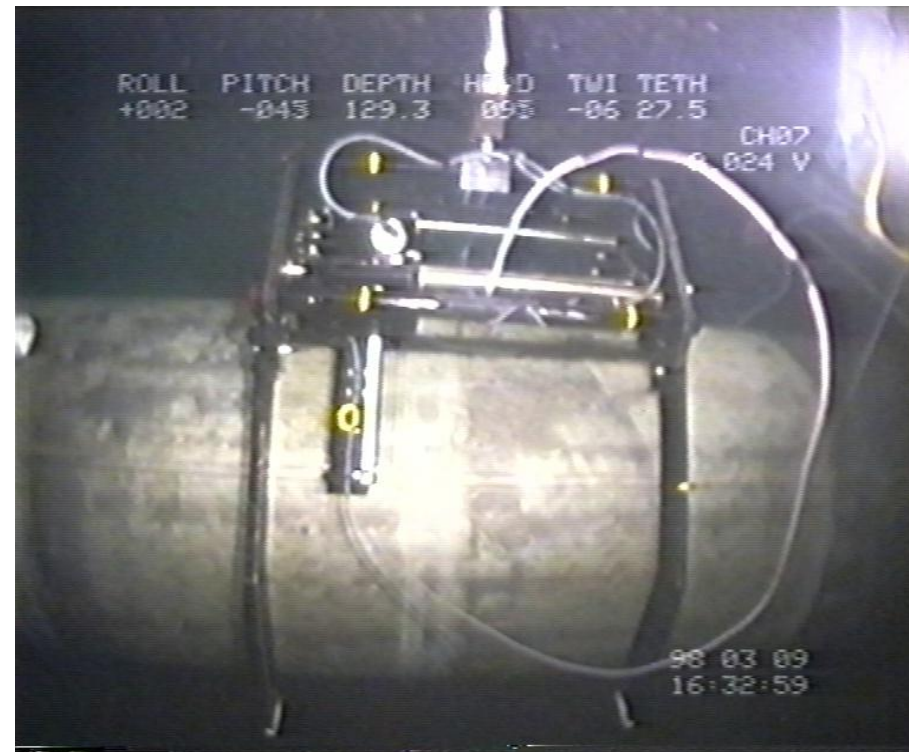


- Steel structures offshore and onshore may degenerate because of:
 1. Erosion
 2. Fatigue
 3. Corrosion
 4. Extreme loads
- Theory and knowhow is getting better and we are able to forecast most of the degeneration
- But ... for verification of our estimate, inspection and monitoring is needed.
- Data from Inspection and Monitoring is the key to be better in what we do.

Projects 2007



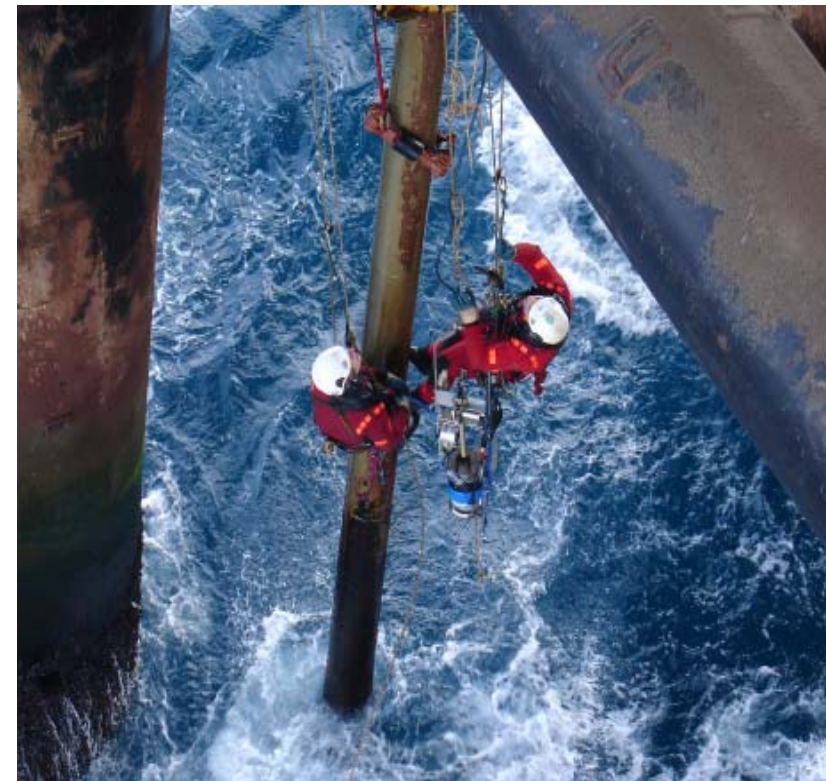
Eldfisk: Hot Tap Sub-Sea Inspection



Project 2007 - 2008



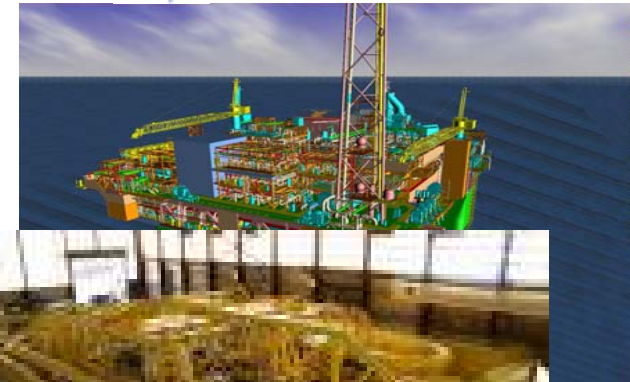
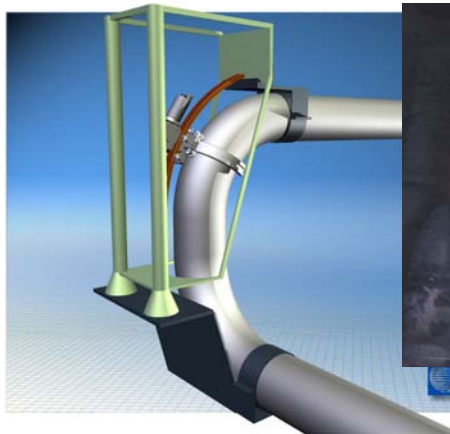
Gyda / Ula :
Monel Inspection Dry/wet



Project 2007



Preparing for bend scan on Gjøl:



Project 2007



Preparing bend scan for Kristin



Project 2007

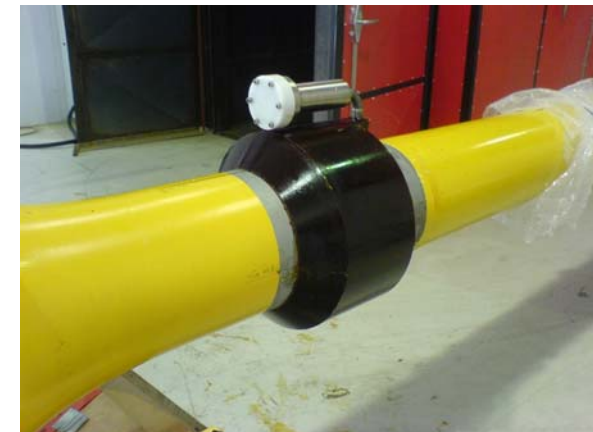


SEAFLEX

FMC

RMS on TTRD work over risers:

- Strain measurement system based on strain gauges for TTRD work over risers (TTRD: Trough tubing rotary drilling)
- Customer: Seaflex / FMC



Project 2007



Differential ERA sensor system:

- Differential angle measurement system for lower flex joint
- Customer: Diamond Offshore



Project 2007 - 2008



N. Line cylinder response monitoring system:

- Response monitoring system for tension system actuating cylinder. Measurements performed are strain, acceleration and pressure on several locations
- Customer: Node Art



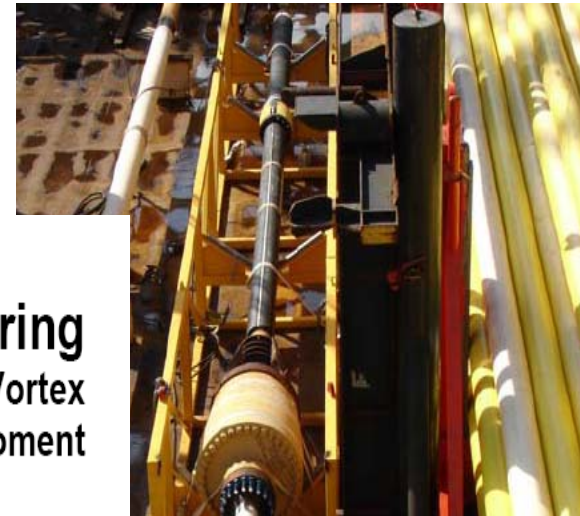
Project 2005 - 2006



- Thunder Horse

Steel Catenary Riser monitoring

-For deep water development, High speed data sampling for Vortex Induced Vibration tracking, flexjoint deflection angle and bending moment



Project 2006



Dalia Motion Recorder system :

- Customer: APL
- Measurement of Heave, Roll & Pitch for offshore loading buoy, EEx zone



Project 2007



All BP Jackets in the North Sea:

- Eddy Current of Sub-Sea structures
- Customer: BP

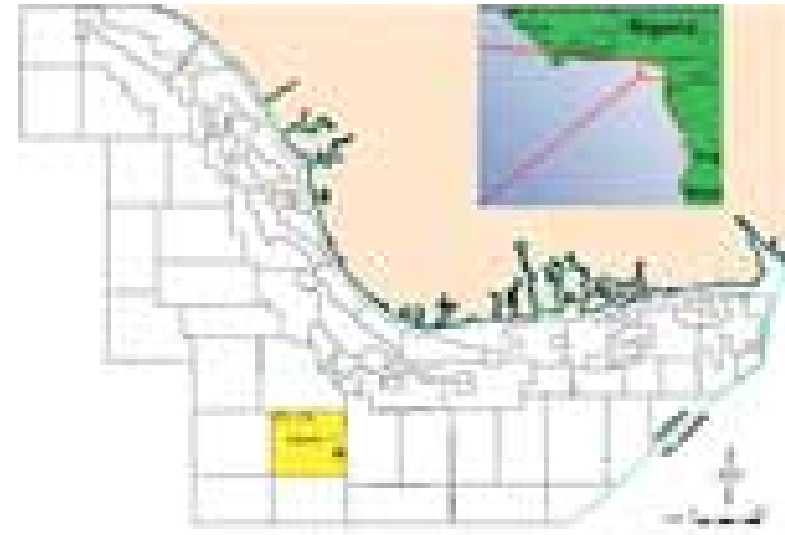


Project 2007



Agbami in Nigeria :

- Flexible Pipe "Integrity"
- Customer: Technip / TOTAL



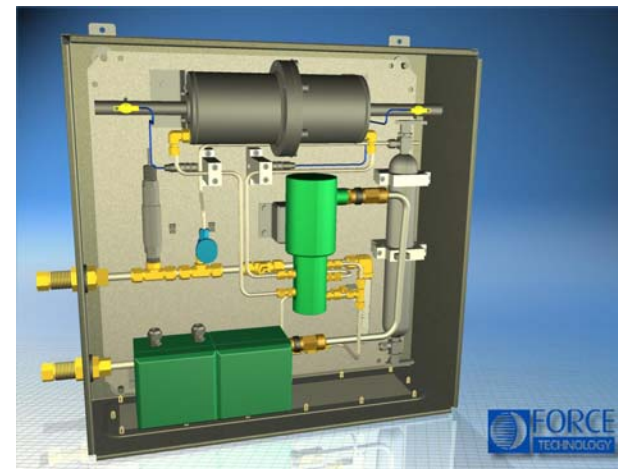
Project 2007



subsea 7

Chestnut in the North sea :

- Flexible Pipe "Integrity"
- Customer: subsea7





Thank you for your time

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