Developments in Subsea Ultrasonic Inspection
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Objectives

- **Sonomatic Background**
  - Unique Inspection scanners & ROV Deployed Tools
- **ROV Inspection Tool Development Phase**
  - Project #1 = North Sea - 2” Piggyback Methanol Line
  - Project #2 = West of Shetland - Expanded area of inspection
- **Project Background**
- **Project Requirements** - Equipment goals & Challenges
- **ROV Tool Function & ROV Tool Integration Trials**
- **Offshore Phase**
- **Inspection Data**
- **Future**
- **Questions**
Sonomatic Background

- Design, development, manufacture & implementation of inspection tools and services for 30+ years.
- Engineering design, development and implementation of ROV deployed inspection tools has been ongoing since 1989.
- Recent developments was a client requirement for specific application.
  - Accelerated the design process to allow a fully working tool to be designed, developed, fabricated and trials run.
- Project #1 = North Sea - concept, detailed design, manufacturing and testing completed in eight months. Deployment of tool in October 2010
- Project #2 = West of Shetland required approximately 120 days.

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Manually propelled position-encoded scanner – 1989 - Present
Gooseneck welds and ovality scanner - 2008

Buoy supporting risers

Flexible risers

Gooseneck

OLS Base

Structure on seabed
IP Verification - 2009 - Present

Medium resolution

TOFD

High resolution
Deployed Jan 2011
West of Shetland
Deep Water

Deployed Oct 2010
Southern North Sea
Shallow Water

Deployed Jan 2011
West of Shetland
Deep Water

Original design prototype
ROV Inspection Tool Development

Phase

- Initial request for inspection solution was made by client in February 2010
- Concepts were developed and discussed
- Detailed design was completed April 2010
- Manufacturing completed by August/September
- Integration trials with Deepocean ROV started in September
- Inspection tool trials done Aug/Sept
Project Background

- Southern North Sea Development
  - **WD** - Shallow Water -250m
  - **Purpose** – Localized Corrosion due to sand deposits
  - **Inspection area** – 500mm
  - **Inspection method** – Corrosion Mapping
  - ST2 - API-5L-X65 356mm OD, 25.4mm nom wt, 450um FBE coating
  - ST3 - API-5L-X65 356mm OD, 25.4mm nom wt, 450um FBE coating
  - **Obstacles** – 2” Methanol Piggyback line
  - **ROV** – DeepOcean
  - **Vessel** – Northern Canyon

- West of Shetland
  - **WD** - Deep Water – 500m
  - **Purpose** – Integrity of MDPE Liner at weld links and corrosion
  - **Inspection Area** – 1 meter
  - **Inspection method** – Corrosion Mapping & TOFD
  - 10” x 60 Pipe OD 273.1mm wt 15.8mm with 1.5mm FBE external coating and 10mm MDPE internal liner
  - • 12” x 60 Pipe OD 323.9mm wt 19.1mm with 0.5mm FBE external coating and 10mm MDPE internal liner
  - **ROV** - SubSea7
Project Background – Southern North Sea

Inspection Difficulties

- The piggybacked 2” methanol line on the pipeline provides restricted access around the pipeline.
- The pipeline is trenched and backfilled and as such access around the pipe is limited.
Project Background – West of Shetland

Inspection Difficulties
- 1m inspection coverage
- MDPE Liner Integrity at Weld Link Connections and Pup Pieces
- Instances of Blistering of liner Post Localized Repairs & Becoming detached.
- The pipeline is trenched and backfilled and as such access around the pipe is limited
Project Requirements – Southern North Sea

Inspection Requirement

- Identification of most likely sand locations along the length of the pipeline using a model done by sand modelling study performed by MSi Kenny
- Quantification of the amount of sand in the pipeline at the identified locations using the Tracerco diagnostic scan tool deployed by ROV
- Measure pipe wall thickness to determine condition of pipeline at these locations

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**Project Requirements – West of Shetland**

**Inspection Requirement –**
*Identified during 2008 repair evolution*

- Determine if MDPE liner has been blistered (following localised repairs)
- Determine if MDPE Liner may have detached from its retaining clamp and exposed the carbon steel pipe surface.
- Determine the integrity of Transition Piece to Weld Link welds (Weld 3) where galvanic corrosion has been evident due to possible over blending of the internal inconel overlay at weld fabrication.
- Confirm location of MDPE liner (minimum scan coverage 1m).
- Inspect pipeline parent material to establish if any corrosion has occurred behind any liner blistering.
- Inspect internal inconel to carbon steel transition area for possible galvanic corrosion (minimum of 50mm either side of transition area).

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ROV Tool Functional Trials

- The SonoSim ROV inspection tool was function tested prior integration trials with ROV
ROV Tool integration Trials

- The purpose of the trials onboard the Northern Canyon was to complete a system test on the electrical/electronic interface between the Sonomatic ROV deployed scanner and the designated ROV.

**Components trialed by Sonomatic:**
- Sonomatic Control POD
- DC Servo motors
- UT probes (on test samples)
- All interface cabling
Offshore Phase – S. North Sea

- S. North Sea project mobilized Oct 2010
- Successful ultrasonic inspection completed on areas of concern

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Inspection Data – S. North Sea

- Ultrasonic inspection completed on 3 areas of concern
- Reliable ultrasonic data was collected in all areas inspected
Inspection Data – West of Shetland

- Ultrasonic inspection completed on two (2) areas of concern
- Reliable ultrasonic data was collected in all areas inspected

Scan Location A
- Ultrasonic inspection completed
- Black Rubber Coating
- Transition to Coating
- Coated with 4mm FBE

Scan Location B, C & D
- Ultrasonic inspection completed
- Inconel Cladding
- Transition to Coating

Scan Location E
- Ultrasonic inspection completed
- Inconel Cladding
- Transition to Coating
- Coated with 4mm FBE

Color File
Value Added -

- **Safety** – (S. North Sea) - Eliminated the need for Diver deployed inspection
- **Technical** – Provides high resolution data acquisition for use in FFS and in conjunction with MFE &/or UT Pig data for Extreme Value Analysis.
- **Costs** – Significant financial savings using ROV Vessel vs. DSV.
  - Estimated savings £500,000
- **West of Shetland** – First ever data acquisition method providing significantly improved planning and analysis of pipeline behavior.
Nautilus 3000

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Acoustic Resonance Technology (ART) DNV

ART insonifies a "footprint" area insonified, and creates resonances. The re-radiated energyspectra comprises all information of the area. Analysis of this resonant energy is basis for ART algorithms.

Optimum standoff:
100mm in air or 500mm in water

- Offshore Risers
- Subsea insulated pipe
- High temperature
- Couplant free corrosion mapping (high speed)
Thank You

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