Development of an Advanced Subsea Inspection Capability

Manufacturing for Subsea in the North West, Manchester – November 2014

www.sonomatic.com
Company overview

• Sonomatic formed over 30 years ago, to bring emerging inspection technologies in the Nuclear Industry to Oil and Gas and other industries. Field Services since 1988

• Design & manufacture through Warrington head office. Depth of expertise, quality & responsiveness of supply chain are critical

• 145 employees (34 in 2005) 6x PhD, 4x NDT Level 3

• Turnover approx £23m (£2.2m in 2005)

• Company is privately owned – US shareholders committed to development (reinvestment for growth). Services only since 2005
Company divisions - Integration

Sonomatic Field Services
**Advanced Non-Intrusive Inspection Technologies:**
- Time of Flight Diffraction
- Corrosion mapping
- Automated Pulse Echo
- Long Range Ultrasonics
- Surface crack detection (ACFM)
- Inspection of inaccessible areas (CHIME/Multiskip)
- Automated sub-sea tools

*Under development:*
- SH-EMAT technology, incl tomography – *Warwick university*
- Dynamic Response Spectroscopy (DRS) – *Client sponsored*

Sonomatic Integrity Services
**Integrated Engineering support services:**
- Non-Intrusive Inspection (NII) Assessment/Planning
- Inspection planning and data management
- Fitness for service assessment
- Statistical analysis
- Inspection modelling
- Advanced data processing

Sonomatic Rope Access & Inspection Services
**Conventional & non-core inspection services:**
- Rope access
- Manual NDT services
- Advanced ET
- Advanced RT
- Condition monitoring
- Lifting equipment

Sonomatic Engineering
**Technology development and support:**
- Mechanical design & systems integration
- Digital & analogue electronics
- Software engineering

Design, develop & support technology and applications for use by our own specialists
Manually propelled TOFD* scanner

- Rare earth magnetic wheels
- Optical encoder – positional feedback
- 2x UT channels
- 250m umbilicals
- 200m depth rating

*TOFD = Time of Flight Diffraction
Nautilus dual-axis scanner

- Clam-shell collar
- Rack & pinion drive
- Dual axis DC Servo
- Optical encoders
- 8x UT channels
- 250m umbilicals
- 200m depth rating
- TOFD (welds)
- Auto UT (welds)
- Corrosion mapping (pipelines)
Subsea hot-tap – 3\textsuperscript{rd} axis
Inspection qualification
Ovality scanner
Dent mapping – 3D view
Strains on ID and OD

Max Principal Strain @ID

Max Equivalent Strain @OD

Wall Thickness Variation
FEA on dented pipeline
ROV deployment – ROV-iT

• Deployed by work-class ROV to 500m, rated for 1500m (3000m)
• Held in position by hydraulic clamps or sticky foot
• Power, hydraulics & communication via ROV (requires integration)
• Corrosion mapping, AUT, TOFD & ACFM (surface crack detection)
ROV-iT range: 6” > 30”

- Deployed by basket
- Internally developed hot-stab capability
Validation @ NBL 12” ROV-iT
12” ROV-iT: Vertical riser inspection
Case study – corrosion mapping

Inconel Cladding Coating Transition

2955mm 55mm

12 o'clock 6 o'clock

3 o'clock 9 o'clock

12 o'clock

3010mm Compression joint

Carbon Steel Weld 4

Flow Colour File

10.7mm measured

9.3mm measured

11.9mm measured

Similar area from 2010 and 2012

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Subsea pipeline inspection services

• ILI verification
  - Statistical analysis of ILI data
  - Hi-resolution, hi-quality UT
  - Re-calibrate ILI data
  - Clamping guidance

• Un-piggable lines
  - Detailed corrosion risk assessment
  - Targeted hi-res, hi-quality inspections
  - Understanding of nature of degradation

• Compliancy
  - Dry gas lines
  - Verify absence of degradation

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Accuracy of corrosion mapping thickness measurement
MagRover subsea steerable scanner

- Magnetic wheels
- Joystick control
- Level indicators
- Depth Gauge
- Cleaning heads
- 3x cameras & lights for GVI & CVI
- 8x UT channels
- ACFM

- Can be attached above waterline and driven to mud-line
- Proven in splashzone
MagRover subsea steerable scanner

ACFM* deployment by magnetic wheeled scanner

Magnetic wheeled scanner
Fitted with buoyancy for deployment by inspection class ROV

*ACFM is surface crack detection technology
MagRover adaptation for long-neck flanges
Caisson inspection
1. Excite steel with a broad range of low ultrasonic frequencies

2. Steel resonates at a natural frequency determined by its WT:
   \[ f = \frac{\sqrt{E/\rho}}{2WT} \]
Dynamic Response Spectroscopy (DRS)

Figure 19. PZFlex model of a 0.3 MHz probe with 30mm standoff from 5 mm fibreglass on a 10 mm steel plate. Left: model geometry. Right: wave propagation.
Subsea small bore pipe weld inspection

- 6” x 14mm duplex
- 2” x 4mm
EMAT scanners

- **EMAT** = Electro-magnetic acoustic transducer
- Transmits wave around pipe circumference to detect corrosion
- Level indicators
- Hydraulic jacking system
Moorinspect project
Summary

• Subsea applications are varied and require versatility – wide range of skills
• Due to unpredictability of the subsea market, availability of resources on short lead times is important
• Quality and reliability are paramount as failures have significant impact – parallels with automotive, aerospace & power generation
Thank you for your attention

Questions?