ACOUSTIC LEAK DETECTION
OUTLINE

- Time line – Acoustic Leak Detection & Condition Monitoring
- Technology Requirements
- Naxys Acoustic Leak Detector
- Qualification Status
- Field Experience
- Way forward
TIME LINE – LEAK DETECTION & CONDITION MONITORING

1986
Statoil
Installed the first HC Leak Detector: Collector with capacitive sensor

Troll Pilot
Subsea water removal & injection
Requirements:
• Hydrocarbon Leak Detection (HLD)
• Condition Monitoring (CM)

1990
Troll Pilot [2001]: Demonstrated Acoustic Condition Monitoring

2000
Ormen Lange
Subsea development
Requirements:
• HLC
• Monitoring of vibrations

2005

2007
Ormen Lange delivery (2005):
• Acoustic Leak & Vibration Detector
• Electronics: ISO 13628-6 qualified

2010
1st generation Acoustic Leak Detector

2011
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TECHNOLOGY REQUIREMENTS

Background
Advanced Subsea Installations
Focus on safe & secure production
Focus on environmental issues
→ Increased need for monitoring

Non-intrusive
Minimizes sensor interference
→ monitoring does not impose increased failure modes on system being monitored

Robust & Long design life
• Robust sensor design
• 25 years design life
• No requirement for maintenance
• Operating depth: 2000m
• ISO 13628-6 qualified

High performance
• High Detection rate
• Wide coverage
• Directional detection

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ACOUSTIC DETECTION & CONDITION MONITORING

Sequence of events during pump shut-in

- Shut-down of water injection pump
- Operation of return valve
- Unknown
- Operation of needle valve

Tordis IOR (Statoil)
NAXYS ACOUSTIC LEAK DETECTOR

**ROV Lifting interface**

**Protective Frame:**
Titanium Gr. 2

**Fishtail connector & docking station**

**ROV operated locking pin**

**Template Docking Station**

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**Hydrophone array**
- Receiver of acoustic energy
- 22 spatially distributed sensors
  → directional detection
- Successful Arrhenius life cycle testing
  → 25 years design life
- Qualified according to ISO 13628-6

**Electronics canister**
- Subsea processing
  → Analog to Digital
  → Array processing
- 1 atm. canister
- Glass to metal penetrator
- Oil filled chamber
- Anguilla hose & wet mate-able connector
Topside Subsea Processing

- User-friendly interface
- Status: OK, Warning, Alarm
- Trend values
- Status Message
  - Ethernet
  - Modbus
  - CAN
  - IWIS
  - Modbus/TCP
  - FTP
  - UDPIP

Hydrophone receiver array

Naxys support

Transparent links

Subsea Processing

5 minutes ringbuffer
FIELD EXPERIENCE: TESTS

- Tank tests
  Verified the technology concept

- Deepwater inshore tests
  Leak detected down to
  0.8 l/min, dP=5bar @ 10m distance

- SINTEF seawater basin tests
  Gas Leak
  Gas Leak
  Oil Leak
  Acoustic Leak localization

SINTEF
Foundation for Scientific and Industrial Research

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FIELD EXPERIENCE: NAXYS DEEPWATER STATION

Umbilical
• Power
• Communication

Leakage nozzle

Leak simulation:
• Nozzles: 0.4-6.0 mm
• Separate line for gas and liquid
• Mixing of gas and liquid subsea
  → Variable GOR

Naxys
Offices,
Workshop &
Test Facilities

210 m (689 ft)

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WAY FORWARD

- Qualification of Acoustic Leak Detector to 3000 m
- Procedures for warning & alarms
  ➔ further development with Operators
- Increase sensitivity of point sensor
SALD – SINGEL ACOUSTIC LEAK DETECTOR

Function: Detection of Hydrocarbon Leaks
Sensors: 1 Naxys Hydrophone
Coverage: 5 m radius, Medium leaks (5-50 liters /minute)
Installation: By ROV
Status: Qualified to ISO 13628
Pressure: Tested to 225 Bar
Design life: 25 years

Applicable for retro-fit
THANK YOU FOR YOUR ATTENTION