Smart monitoring of subsea pipework
Agenda

- Onboard signal filtration, data processing, and data interpretation/for the following subsea applications:
  - Acoustic sand monitoring
  - Acoustic Corrosion and Erosion monitoring
  - Vibration monitoring
Subsea monitoring limitation

Acoustic instrumentation generate big data. Big data cannot be transmitted to surface/shore, hence the need for subsea data processing.
## Standard Interfaces

<table>
<thead>
<tr>
<th>Name</th>
<th>AKA</th>
<th>Details</th>
<th>Data rate</th>
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<tr>
<td>SIIS L1</td>
<td>4-20mA</td>
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- Bus
- Fault tolerant
- Stable
- Defined
- 50 kbit/s
Subsea Sand detector

Sample rate: 10Mhz ~ 120Mb/s = too much
Output: one value per second
Onboard sand calculation

Safety check

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> roof?
Corrosion Erosion Monitoring

Permanent “active” acoustic, non intrusive wall thickness monitoring system.
What Does it do?

- Real-time monitoring of average wall thickness
- Covers up to 60% of measuring area
- Measures up to 56 individual paths
How does it work?

- Induced current in magnetic field creates a force
Processed data

- Sample rate: 4Mhz
- 2000 samples per measurement / path
Transmitted / user data

Defect Length in CM / Measurements in MM

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Graph showing wall thickness change over time for different channels.

THE LEADER IN SAND, PIG AND CORROSION-EROSION MONITORING
Example #1

Application: Erosion
Type: Integrated
Interface: SIIS L3 (Ethernet)
Example #2

Application: erosion
Type: Integrated
Interface: SIISL2

Fully integrated, frequent measurement trough bend
Subsea Vibration monitoring

Instrument installed on 6” flex loop

Instrument installed on 2” injection line
MicroElectroMechanical Systems

- Accurate
- Sensitive
- Power friendly
- Very Small

Mite on top of MEMS mechanic
Hardware overview ASVD

Data logger Board

DSP II

Accelerometer
3 axial accelerometer

Piezo 1
Piezo 2

RS485 (serial)
CAN Bus (SIIS L2)
USB
Digital IO
Relays
On-board signal processing

- Sensing
- Filtering
- A/D conversion
- Spectral analysis
- Integration
- Peak/RMS calculation

Derived quantities:
- Peak acceleration
- RMS velocity
- Peak frequency
- Effective frequency
- Crest factor

Spectrum output
Raw data output
ASVD placement

- ASD
- MPFM
- Choke valve
- Flow
- Probes
- Connector
ASVD placement
Stand-Alone Vibration Monitor (LPHP)

- High precision accelerometers (3 axes)
- Low power accelerometers (3 axes)
- Gyroscopes (3 axes)
- Magnetometers (compass) (3 axes)
Hardware overview LPHP

- HP X-Acc
- HP Y-Acc
- HP Z-Acc

Flash memory

Processor

Motion Chip
- 3axial accelerometer
- 3 axial gyroscope
- Magnetometer

Connections:
- RS485 (serial)
- Future: Ethernet SIIS L3
- USB
- Digital IO
- Relays

THE LEADER IN SAND, PIG AND CORROSION-EROSION MONITORING
Temporary / inspection
Thank you for your attention!

Any questions?

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