Testing of Leak detection systems

- Testing of sensors from prototype to operation subsea

03.11.2011 – Truls M Larsen
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Introduction

• Why all these comprehensive tests?
  – Sensors fail!
  – Other sensors give updated/live values
    • Sensor integrity verification
  – Leakage sensors are silent sensors
    • No leakage or “dead” sensor

• Building confidence in the product and its reliability
Sensor Qualification Testing

• Typical requirements:
  – ISO, API, materials etc...

• Does this make the sensor work?
  – What is principle behind detection?
  – What is the environmental conditions?
  – What is the criterias for detection?

• Apply FMECA process in the design (FMIRR in DNV RP A203)
  – Standard “parts” through general/international standards testing
  – Be stricter than “usual” on operational elements
    • Creative thinking – testing to “destruction”/limit testing
    • Determine limits
Qualification acceptance criteria

• Detection criteria not set by Oil companies
• FMC requirements for leakage detection
  – Primary:
    • Retrievability
    • Design life 25 years
    • Leakage rate
    • Distance to leakage
    • Direction of leakage
  – Secondary:
    • Minimum pressure drop from pipe to sea (for noise measurement)
    • Leakage position (3D coordinates)
  – Current values driven by Naxys capabilities
    • Naxys – FMC qualified supplier
Sensor Production testing

- Standard tests:
  - Lifetime of electronics and electric “elements”
    - ISO, API, customer specific requirements, etc...
    - Note: harsh testing reduces lifetime...
  - Hyperbaric integrity – Mechanical strength:
    - He-leak test of seals
    - Hyperbaric pressure test of full assembly
    - Requires diagnostic sensor for detecting water intrusion
  - Final Acceptance Test – Functionality test
    - Does the sensor work as specified/required?
Production - extended

- Other tests - Extended functionality test
  - Leakage detection under simulated conditions
  - Leakage detection under semi real conditions
  - Leakage detection under real conditions
  - All or one unit

Functional test @ quay side
Field specific qualification

• Test project/installation specific data
  – One unit
  – Real conditions
    • water depth & water temperatures
    • Similar fluids – density, viscosity, compressibility
    • Distance – at the limit of sensor
    • Leakage flow rate and/or differential pressure

• Need for deep water stations and/or large pressure vessels
Sensor Subsea System integration testing

• Simulators – Can the signal be interpreted and sent topside
  – Output signals go through long chain of modules: SCM, SPCU, TPU, data collector machines, etc...
  – Testing one step at a time

• Must “perform” as sensor
  – Power consumption
    • Inrush
    • Steady state
  – Signal output
  – Receive signals
    • Configuration
    • Software download
Integration testing – challenges

- Simulators often needed before sensor production starts

- Software
  - Advanced software for subsea processing are highly configurable
    - Wrong configuration supplied in sensor and/or simulator

- Wiring
  - 12 pin connectors & TCP/IP or Modbus/TCP
  - Which is receiver/sender
Sensor - Complete system integration

- Commissioning of subsea system
  - Sensor communication tested and established
Testing during operation

• Suppliers/vendors should
  – Propose methods of testing
  – Produce test equipment
  – Produce test procedures with acceptance criteria
  – Ref. presentations:
    • Experience with acoustic leak detection – Vega
    • Experience with acoustic condition monitoring - Tordis IOR
    • ALVD Leak detection experience on Ormen lange
Current Gap

- Requirement for redundant systems
  - Full redundancy of the sensor itself
  - 2 separate technologies
- Current solution
  - Phaze and Naxys (Naxys AL(V)D or SALD)
- New suppliers with new/other technologies are needed
Future gap

• Sensor reliability data good enough for non-retrievable systems

• Fields producing at lower pressures
  – Leakage detection of water into pipe lines

• Smaller, cheaper sensors for multiple installations inside subsea compressor station and separation stations units

• Production pipe line leakage detection across 10-100s of km
Conclusion

• Industry still in its "childhood" – need close follow up:
  – supplier – system supplier – end customer – end user

• DNV RP F 302 – Selection and use of subsea leak detection systems
  – Suitable General decision making tool
  – Not suitable for the systems nor sensor suppliers

• How many leakage detection sensors can you buy for the total amount of money an oil spill costs?