Recent Advances in Riser Monitoring Systems

Shreenaath Natarajan
2H Offshore
Riser and Conductor VI V
Why Monitor Risers

- Risers are **fatigue critical** structures
- **Complex interfaces** at the vessel and the seabed
- Multiple **assumptions** involved in **design data** and methodologies
- Riser **failure** is totally **unacceptable**
Riser Monitoring System Design

- Monitoring Purpose
  - Environment / Vessel motion induced riser response
  - Riser/soil interaction
  - Specific component performance
  - Capture uncertainties in extreme event response
  - Fatigue concern
- Suitable instrumentation
- Data processing requirements
- Data communication requirements
  - Real time / quasi-real time / log & retrieve
- Cost
- Installation
  - Retrofit / Pre-installation / during riser installation
Recent Achievements

- Cost-effective subsea strain sensor
- Acoustic data transmission
- Subsea microphone based flexible armour wire monitoring
Strain Measurement Features

- Conventional electrical foil strain gauges in pressure balanced cylindrical tube
- Bending strains along 2 planes
- 3 micro-strain accuracy
**Strain Measurement**

**INTEGRIstick™ Benefits**

- 3000m depth rating
  - Conventional electrical foil strain gauges are restricted to above surface / near surface
- High resolution suitable to capture small strains causing riser fatigue
- Extremely low power consumption
- Suitable for both standalone and real-time applications
- Cheapest strain gauge option for subsea application
GoM Tahiti SCR Real Time Monitoring System

5 Strain and Motion Sensors Top
11 Strain and Motion Sensors TDZ
Acoustic Logging

Features

- Acoustic transponder and sensors powered by self-contained battery unit
- Acoustic receiver on deck
- Software to process and display on-board
- Low power and high precision accelerometer/inclinometer arrangement
- Electronics adaptable for any type of measurements
Benefits

- Acoustic link enables data communication near quasi-real time
- Reduces complex cabling and risk of damaging the cables
- Low power electronics minimizes power consumption
- Acoustic link enables data logger switching on/off as required, maximizing the battery life
- Provides easy retrofit options using ROV/diver
- Off the shelf monitoring product
Mooring Line Monitoring System

- Sample configuration
- Cable
- Acoustic receivers
- Topside data acquisition package
- INTEGRIPod™-AF’s
Shell BC-10 Mooring Line Monitoring System

Flexible Riser Monitoring
Features

- 1D Axial acceleration sensor
- 2D Angle rate and inclination sensors
- Microphone
Laboratory Tests

- Flexible riser on a test rig to maintain static tension and apply dynamic tension cycles
- Armour wires cut initiated using hand held tools
Laboratory Test Results

- All 30 wire break tests are recorded by the instrumentation package.
Offshore Tests

- Installed near the bend stiffener to measure the background offshore noise detected.
- Armour wire break noise is clearly distinguishable compared to:
  - Background noise
  - Impact due to dropped objects or collision.
FLEX ASSURE™
Flexible riser monitoring system

1. INTEGRI™ pod™ located on riser below bend-stiffener
   - Multiple sensors recording riser movement and response

2. INTEGRI™ pod™ on flexible connector recording vessel movement. Will also detect the presence of gas or hydro-carbons in the I-tube

3. Intelligent software processing. Software will sound alarms at pre-defined threshold values.

4. Satellite or internet communication to shore.
Conclusions

- **INTEGRI stick™**
  - Low power and more reliable electronics
  - High resolution
  - Cost effective

- **INTEGRI pod™ - AM**
  - Acoustic transmission reducing complex cabling
  - Reduced risk of cable failure compared to a hardwired system
  - Instrumentation is away from critical path of installation
  - Field proven technology

- **FLEX ASSURE™**
  - Novel concept turned into a reality
  - Capture flexible riser response near critical riser-vessel interface
  - Early identification of armour wire rupture