Subsea Integrity Practices in GoM – A Case Study

Session 9: HSE
SPE Workshop
21st October 2011
Objectives

- Integrity Management Philosophy
- Performance Assessment Methods
- Integrity Issues and Mitigation Strategy
- Summary
Integrity Management Philosophy

• Assure fitness-for-purpose of the subsea system
• Compliance with regulatory requirements
• Effectively manage –
  • Risk to personnel safety
  • Risk to environment
  • Availability of asset
• Address threats arising from –
  • Internal (Corrosion, Erosion, Blockage, etc.,)
  • External (Corrosion, Impact, Structural Stress/Fatigue, etc.,)
  • Ageing related problems
  • Environment uncertainties
IM Procedure

- DFI Dossier
- Inspection data
- Monitoring data
- Operational experience

Risk based IM Plan

- Inspection Requirements
- Monitoring
- Mitigation Needs
- Operational Limits

Shreenaath Natarajan
Subsea Integrity Practices in GoM – A Case Study

Performance Assessment Methods
Performance Assessment Methods

1: Direct

2: Indirect

VIV FATIGUE DAMAGE MONITORING
6 month period

Monitoring period
Integrity Issues and Mitigation Strategy
Failure Modes

- **Internal**
  - Internal corrosion – SSCC, HIC, CO2 corrosion
  - Erosion
  - Blockage – wax and hydrates
  - Polymer degradation
- **External**
  - Structural overstress
  - Structural fatigue
  - External corrosion
  - Impact
  - Structural wear-centraliser
Issue 1 – Environmental Uncertainties
Issue 1 – Track Environmental Records

- Environment record tracked against design limits
- Identify the events that exceed design limits for further investigation
Issue 2 – Riser Vortex Induced Vibrations (Failure Mode - Fatigue)

Target KPI -

Extreme Loads, Long-term fatigue
Issue 3 – Flexible Riser Internal & External Corrosion

Issue
• Degradation methods difficult to predict or measure
• Few early warnings from external visual inspections
• Annulus volume testing is subjective

Recommendation
• Improve reliability and accuracy of volume tests
• Corrosion modeling or methods to predict onset of corrosion
• Embedded fiber optics for monitoring
• External inspection/scanning tools
• Acoustic monitoring
Issue 4 – Installation Issues

- **Issue**
  - High surface wellhead bending moments
  - Estimated fatigue life reduced to 2 yrs from 20 yrs
- **Cause**
  - Missing centraliser during installation
- **Recommendation**
  - Retrofit foam centralisers
  - Continuous monitoring of wellhead bending moments
Issue 5 – Material Degradation

- **Issue**
  - Flexjoint elastomer deterioration
  - Increased fatigue and extreme loads at riser-vessel interface
- **Source**
  - Prolonged exposure to high temperature/pressure
Issue 5 – Material Degradation

- Recommendation
  - Develop failure prediction methods based on P&T data
  - Improve CVI tools and modeling methods
  - Improved elastomeric materials
  - Implement learning’s from drilling riser elastomers
Issue 6 – Coating Breakdown (External Corrosion)

• Issue:
  • External corrosion

• Cause:
  • Installation damage
  • Coating application procedure

• Recommendation:
  • Monitor CP readings
  • Surface preparation is key to effective long term coatings, which is the barrier to external corrosion
  • Design should consider extending the coating to reduce coating transitions
Issue 7 – Cathodic Protection Premature Depletion (External Corrosion)

- Issue:
  - Insufficient cathodic protection and hence external corrosion
- Cause:
  - Inadequate CP design
  - Increased current drawn from other components that should have been electrically isolated
- Recommendation:
  - Monitor CP readings (not always reliable)
  - Retrofit anodes, if depleted
  - Guided Wave Ultrasonics
  - Develop on-line methods for in-service corrosion prediction
Issue 8 – Marine Growth

• Issue:
  • Loss of VIV suppression efficiency
  • Increased drag on the system

• Recommendation:
  • Regular cleaning of marine growth
  • Develop efficient and effective cleaning tools
  • Improve anti-fouling treatments
  • Evaluate fouled fairing performance
Issue 9 – Flowline Snagging

Issue
• Remaining strength capacity

Cause
• GoM following a hurricane
• Final tilt – 8.8deg
• Response suggests 130 to 150te pull from flowline

Recommendation
• Detailed FEA to determine fitness-for-purpose
• Conductor plastic strains ~ 4%
Issue 9 – Subsea Components

Issue
• Visual inspections gives little or no information on the health status

Recommendation
• Hydraulic fluid consumption KPI
• Control valve failure prediction
• Subsea communications health
• Electrical insulation health
• HPU pump cycle monitoring
Assuring ongoing availability of the subsea systems by:

- Practicing and budgeting integrity management as a compulsory activity instead of being reactive to integrity problems considering opportunity cost of shutdowns
- Ensuring competency of the personnel involved in all stages of IM process and in all disciplines
- KPI tracking through integrity monitoring and inspection thus tracking the performance over time and not just a snapshot in time
- Need to mature the monitoring systems available for deepwater systems
- Need to improve/develop methods for real time assessment of accumulated stress, fatigue, and corrosion
- Designs should include capacity for inspection or long term monitoring methods
  Design consideration for mitigation and/or replacement.