IMR Best Practice - Practical Lessons from a Decade of Subsea IM

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Introduction

○ Background
  – Early 2000; applied design tools to look at integrity of SCR Strakes
  – Expanded to cover all in-water equipment

○ Different Approach
  – Engineering came first
  – Use available data and management
  – Typical engineering reports
  – Wrapped the process around it all

○ Today’s Objective
  – To look at some practical lessons from a decade of practice
Complex system – Straightforward Approach

○ Plan
○ Do
○ Check
○ Act
Complex system – Simple Approach

**Integrity Management**
- Data gathering/retention
- Risk Assessment
- IM Plan
- Inspection procedures
- KPIs
- Life Extension
- Corrosion Assessment

**Inspection Repair Maintenance**
- ROV GVI
- Pipeline positioning, spanning
- Strake cleaning
- FlexJoint Inspection
- Pod/Choke change out
- CP survey
- Specialty tooling
Plan

- This is an Engineering Function
  - Risk Assessment
  - Safety Case
  - Prescriptive
- Documented list of activities where each action confirms a barrier and no new hazards
- Based on the intended design – access to design intent required!
- Requires expertise of the system and relevant failure modes
- Best completed at the end of the project phase

<table>
<thead>
<tr>
<th>Consulting &amp; Front End</th>
<th>Design &amp; Construct</th>
<th>Hook-Up &amp; Commission</th>
<th>Operate</th>
<th>Decommission / Divest</th>
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<td>Front End consultancy</td>
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IM Services
- DFIO
- IM process
- Asset IM plan
- Baseline
- As-built
- Risk Assessment
- Inspection procedures
- Inspection/support
- KPIs
- Direct assessment
- IM Plan
- Anomaly management
- Life Extension
- Corrosion
- Defect Assessment
- Maintenance
- Repair management
- IM Software
- Specialty tools
- Records for ownership transfer
- Sale due diligence survey
Inspection

- GVI is cornerstone of most IM plans.
- Approach:
  - Understand what information is needed and how to get it
  - Establish limits or guides before hand
- Many of the threats are not visually understood
Baseline Inspections

Baseline inspections identify when system deviates from design.
### Baseline Inspections

Baseline inspections improve MTTF calculations

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<th>Remaining WT (inches)</th>
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- **Nom WT, Min Loss Rate**
- **Nom WT, Avg Loss Rate**
- **Nom WT, Max Loss Rate**
- **Min WT, Min Loss Rate**
- **Min WT, Avg Loss Rate**
- **Min WT, Max Loss Rate**

- Manufacturer Specified minimum WT = 0.180"
- Previously accepted minimum WT = 0.172"

![Graph showing baseline inspections improving MTTF calculations](image)
Trending to Maintenance and Repair

More than video – data gathered allows remediation before extensive damage
Key Performance Indicators

- Gain insight to system behavior with existing information
  - Vessel re-positioning for fatigue
  - GPS data to indicate mooring changes
Combined KPI and modelling

Combining the available data with numerical models adds another dimension

Compliance, Uptime, Efficiency
Trending forward – Subsea Control System KPIs
Big Data

- Vehicle Data - ADR 79/01 & 79/02 (2006)
- Internet of things
- The future of offshore is moving subsea
  - HIPPS
  - Pumping
  - Separation
  - Seabed IOR/EOR
Conclusions

- The approach to Subsea IM should be straightforward.
- Planning and execution requires architects and craftsmen.
- Once below the waterline there is an increased reliance on data and condition monitoring.
- Data and inspection combined are a powerful tool in support of maintenance and repair decisions.
- The goal of IM is to facilitate confident decisions which ensure safe and efficient operations.
Questions?

www.clarusintegrity.com
References

- MMS 2008-022 “Effects of Subsea Processing on Deepwater Environments in the Gulf of Mexico”; Multiple Authors, May 2008