RBI for Offshore Pipelines – Challenges in Theory and Practice

Dr. Gundula Stadie-Frohbös / Dr. Felix Weise
RBI for Offshore Pipelines – Challenges in Theory and Practice

- Short Presentation of GL
- Introduction / Basics
- Risk based method
- Example: Offshore pipeline
GL is global service provider in maritime and energy market (oil & gas, renewables)

Maritime
- Classification of 6,800 ships in service
- Plan approval and new build supervision of 500 ships p.a.
- Maritime Systems & Components
- Maritime Solutions

Oil & Gas (GL Noble Denton)
- Technical Assurance
- Engineering Consulting
- Asset Performance & Maintenance
- Marine Operations & Consulting
- Project Execution
- Software Products

Renewables (GL Garrad Hassan)
- Certification
- Engineering Consulting
- Marine Operations
- Measurements
- Software Products
- Training

6,800 Employees in 80 Countries

Strong growth accelerated by acquisitions [EURm]

RBI for Offshore Pipelines – Challenges in Theory and Practice | 2011-12-01 | No. 3
Introduction / Basics
Reasons for leakage

- Impact: 18%
- Anchor: 16%
- Other: 14%
- Corrosion: 38%
- Material - weld defects: 6%
- Material - steel defect: 8%
- Nat. Hazard: 0%
- Structural: 0%
Introduction: What is risk?

Risk = probability of failure x consequence of failure

Risk - understanding

What goes wrong?

Scenario (e.g. fire, oil spill, collision, etc.)

How often?

Probability (e.g. 1 in 1000 years, 1 in 100 years, etc.)

What are the consequences?

Measure of damages (e.g. €1M damage, 3 injuries, etc.)

Risk = probability of failure x consequence of failure
Risk management - covering life cycle of the asset

- Conceptual design
- Detailed design
- Construction
- Commissioning
- Operation & Maintenance
- Life time extension
- Decommissioning
Risk method – Example
GALIOM for Pipelines

Risk = PoF × CoF

- Design Index
- Corrosion Index
- Operation Index
- Third Party Index
- Probability of failure (PoF)
- PoF Index

Consequence of a failure (CoF) shall be assessed carefully! Risk is the combination of PoF and CoF.

Probability of failure (PoF) can often be estimated! Main technical aspects are considered within GALIOM.

- Economical consequence
- Environmental impact
- Reputation and political consequence
- Location Class
- Operation Pressure
- Human safety
- Contents type
- Spill volume
Probability of failure | Two track concept
Semi-quantitative approach

Index procedure leads to an overview of the current status of the pipeline

Remaining life time is directly related to time dependent effects

PoF obtained by worst case result of both assessment methods
Risk matrix & Inspection intervals

Results used to generate inspection strategy which considers cost and safety aspects.

Fixed inspection intervals (e.g. by owner or authority requirements) can be considered as well according to experience of measurements.
Case Study – Two flaws, same flaw geometry and different consequences

Risk development for two equivalent corrosion flaws, with same corrosion growth, however, different consequence levels

Flaw assessment according to RSTRENG
Example: Pipeline
Pipeline

<table>
<thead>
<tr>
<th>Outer diameter</th>
<th>Wall thickness</th>
<th>Operating pressure</th>
<th>Medium</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 in</td>
<td>30 mm</td>
<td>200 bar</td>
<td>Crude oil</td>
<td>29 Jahre</td>
</tr>
</tbody>
</table>
Evaluation of design index

More precise information about the influences of different topics on the individual phases of the “life cycle”, here: “Design” with respect to failure probability.
Assessment of remaining life time - example

Overview of current life time considering different influence factors
Displaying risk in GALIOM

Risk displayed in a 5 x 5 risk matrix

Risk for different pipeline segment
Conclusions

• Support for evaluation of global pipeline integrity
• Shows unknown topics, e.g. missing soil analysis
• Ranking
• Focus on areas with higher failure probability (condition based maintenance) and higher consequences (risk based maintenance / inspection)
What are the Advantages of Performing RBI

- Distinct knowledge of Deterioration Modes and Mechanisms that are affecting equipment
  Look Less – More Focus
- Reduction in Shutdown Inspections in favour of On-Stream Methodologies
  Shorter Shutdowns – Greater Availability
- Develop Run to Failure methodologies for Low Consequence Equipment
  Reduced Maintenance – Cost Saving
- Reduction in Unforeseen Repairs
  Greater Availability
- Ability to identify Risk Mitigation Measures to reduce either the Consequence of Failure or Probability of Failure
  Improved Safety
Thanks for your attention!

Contact details:

Dr. Gundula Stadie-Frohbös

Tel. : 0049 40 36149 991

Email: gsf@gl-group.com