Asset Integrity Management

Significant Issues

IRF Perspective

Stuart Pinks, Chief Safety Officer
Canada-Nova Scotia Offshore Petroleum Board
Halifax, Nova Scotia, Canada

December 5, 2007
Presentation Overview

1. Process Safety
2. Life Extension of Aging Assets
3. Well Integrity
4. Marine/Platform or Rig Interfaces
Part 1 - Process Safety

BP Texas City Refinery Explosion and Fire
(15 killed, 180 injured)
Hazards

**Personal or Occupational Health and Safety Hazards**

- Can give rise to incidents or accidents that primarily affect one individual worker for each occurrence

**Process Safety Hazards**

- Can give rise to major accidents that can have catastrophic effects and can result in multiple injuries and fatalities, as well as substantial economic, property and environmental damage
Process Safety Management
Major Hazard Analysis/Maintenance Loop

IDENTIFY BARRIERS; (SECE’S)

Major Hazard Analysis

Maintenance Management

Performance Indicators

Are They Suitable?

Are The Barriers Being Properly Maintained?
An effective process safety management system measures performance.

Key performance indicators must include appropriate indicators of process safety performance.
Learning Points

Key areas requiring focus:
- Process Safety Culture / Process Safety Management System
- Competency assurance
- Definition / reporting of process safety performance indicators
- Maintenance strategy corresponds with risk of accidents / major accidents
  - Safety and Environmentally critical elements defined
  - Safety and environmental devices not bypassed during maintenance
Learning Points

- Maintenance items properly classified and prioritized:
  - Appropriately resourced
  - Deferral process properly defined
  - Timely supply of materials
  - Project work not prioritized over maintenance work

*There is a need for long term investment strategies and decision making by senior management for maintenance of asset integrity.*
Part 2 - Life Extension of Aging Installations
Elements of Aging that Affect Safety of Installations

- Fatigue
- Corrosion
- Geotechnical and Geological Hazards
- Accidental Damage
- Extreme Weather
- Modifications and Change of Use
- Marine Growth

*If not effectively managed, will significantly increase the risk of major accidents*
Fatigue

- Cracking of welded structural components can have serious implications
- Cracking can occur much earlier or later than anticipated
Corrosion

- General hazard that must be monitored
- Need to assess
  - Effectiveness of sacrificial anodes
  - Coatings
  - Corrosion allowances
  - Corrosion under insulation
Geological and Geotechnical Hazards

Installation Foundation Hazards:
- Pile degradation / failure

Geological hazards:
- Subsidence and slope instability
- Earthquakes
Accidental Damage

- Ship Collision
- Dropped Objects
- Accumulated Damage; includes
  - Minor damage not repaired
  - Missed damage
Extreme Weather

• Design to appropriate loading criterion

• Damage occurs primarily to:
  – Members and joints in steel sub-structure
  – Structural supports for risers
  – Topside structural supports
  – Equipment on lower deck
Modifications and Change of Use

• Addition of new facilities
  – consideration of topside weight
• Change in purpose
Marine Growth

- Increases wave loading on a structure
- Impedes ability of FPSO to depart in emergency situation
An approach to life extension may include these steps:

1. Define current anticipated operating life
2. Define extended operating life (based on field life and other factors)
3. Undertake a comprehensive safety review to confirm continued integrity
   - Assessment of records
   - Testing and inspection data
   - Check against modern codes and standards
   - Redundancy analysis
4. Identify shortfalls / implement improvements
5. Define ongoing inspection / maintenance strategy
Part 3 - Well Integrity
Well Integrity
Norwegian Study, 2006

- 406 Wells Surveyed
- 300 Platform, 106 Sub-sea

- 76 Wells With Integrity Failure or Uncertainty (19%)

- 38 Wells Working under Conditions
  - 28 Shut-in
  - 9 Insignificant Deviation

International Regulators' Forum
GLOBAL OFFSHORE SAFETY
Response to Leaks

Best practices:

- Well data kept complete and current
- All leaks investigated and risked
- Implement necessary mitigation measures
- For annular leaks, integrity of next casing string checked
- Well data (including risk level) updated when leak detected
- Update of operational procedures
# Well Integrity

## Well Risk Categorization

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Risk Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No downhole leak</td>
<td>Acceptable</td>
</tr>
<tr>
<td>2</td>
<td>Marginally degraded well</td>
<td>Acceptable; only if risk factors can be controlled</td>
</tr>
<tr>
<td></td>
<td>Increase in risk</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Severely degraded well</td>
<td>Not acceptable</td>
</tr>
<tr>
<td></td>
<td>Unacceptable risk</td>
<td></td>
</tr>
</tbody>
</table>

*Operations personnel must have a clear indication of well barrier status at all times*
Increased focus required on well integrity issues, including:

- Competency assurance
- Acceptable tolerances and safety factors in design
- Safety in use of leading edge technology
- Maintaining compliance with planned drilling and work-over programs
- General adherence to 2 barrier philosophy
- Verification and condition monitoring
- Adequate maintenance
- Quality and management of well integrity data
Part 4 - Vessel / Platform / Rig Interactions
Types of units and possible interactions

KEY:
- Potential Collision

Visiting Vessel ➔ MODU ➔ Fixed Platform ➔ Passing Vessel

International Regulators' Forum
GLOBAL OFFSHORE SAFETY
Some Recent Examples: Platform / Visiting Boat Collision

- India / July 2005
- Bombay High North platform offshore Mumbai
- Drill rig NCY was also on location
- Platform was struck by a work boat
- Large release / fire
- 22 fatalities
- Major asset loss
Platform / Passing Vessel Collision

- UK–NS. August 2007
- A passing vessel struck the unmanned Viking Echo gas platform
- The ship sank
- Platform damage estimated at $20m
- Sig. loss of revenue
- No loss of life
- Vessel captain jailed for 12 months for being drunk and for entering the 500m zone
JU Rig / Platform Collision

- Mexico / October 2007
- Usumacinta JU Rig working over a PEMEX platform.
- Details are to be confirmed, however, it is understood that:
  - Heavy weather
  - The rig moved and struck the platform
  - Gas release / H₂S
  - Evacuation / 23 fatalities?
Learning Points

• Vessel / Platform / Rig collisions may be rare but they can happen

• Consideration should be given to:
  – Collision avoidance
  – The positioning of risers and their potential for damage.
  – The need for fenders / riser guards
  – ESDV positioning

• The risks associated with collisions and riser damage need to be managed
My Job is Done!

And now over to the Panel ............