Platform Life Extension — Identifying Critical Wells
David Roberts

Offshore Well Intervention
October 2016
Platform Life Extension – Identifying Critical Wells

5th October 2016
D Roberts

Learn more at www.2hoffshore.com
Agenda

- Introduction – technology > design life
- Size of the challenge - cost
- Platform well build
- Corrosion mechanism – accelerators
- Criticality screening
- Remediation methods
- Summary
- Conclusion
Introduction

- 70% global production comes from mature assets
- Advances in technology have extended production lives of wells > design life
- Corrosion related loss of structural integrity and potential for loss of containment
- Abnormal movement, clashes, ruptured flowlines, casing failures

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Size of the Challenge

Installed Operational Offshore Conductors - Middle East

Abu Dhabi (UAE)
Saudi Arabia
Qatar
Iran
Azerbaijan
Dubai (UAE)
Neutral Divided Zone
Turkmenistan
Kazakhstan
Others

Nos.

0 500 1000 1500

0-5 6-10 11-15 16-20 21-30 31-40 41-50 >50

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Structural Failure - Cost Effect

- **Cost (£)**
  - 4M
  - 650K
  - 50K

- **Time**
  - Engineering assessments & scheduled repair
  - Loss of centralisation
  - Connector failure
  - Well collapse
  - Facilities shut-in, engineering assessments and emergency well intervention

Cost includes engineering assessment, design and installation of repair equipment, deferred production and rig time.

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Platform Well Construction

Well built on the conductor – latched or may lift off when hot (Hybrid).

Well built on the surface casing, conductor acts as a marine protector only.

HYBRID – no lockdown? More complex!

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Criticality Screening

Learn more at www.2hoffshore.com
4 Steps to be Considered

1. Calculate well “as-built” weight – Size of the initial forces

2. Measure remaining wall thickness – Quantity of steel carrying forces

3. Assess well criticality – re-model with reduced performance & added external & operational loads

4. Implement corrective method – Fix if required & re-model
Step 1. Well Load (Weight)

Option 1

Well Build Predictive Modelling

Reasonable well data, a load / displacement calibration point is useful.

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Direct Measurement

Option 2
Direct In-Situ measurement ASTM E837

±3% accuracy

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Health Check

- Do in-situ load and model match?
- Has the well maintained its as-built load and GAP?
- Are all the springs still working?
- If structural spring fails the rest will take its share whether they are capable or not!

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STEP 2. Remaining Wall Thickness

- Pulsed Eddy Current (PEC) method – field proven
- Ability to read thickness of “good steel” through thick corrosion / marine product ~ 20mm
- Integrated camera
- Multiple historic surveys gives corrosion rate
- C-PEC measures simultaneously

![Graph showing PEC wall thickness measurements over time](attachment:graph.png)
### Offshore Riser in Splash Zone

#### Colour-coded wall thickness graph

**Jig with PEC probe**

**C-PEC tool with PCE can bypass access problems in D-annulus**

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STEP 3. Assess Well Criticality

- Casing supported
- Revisit well model
- Insert corroded section/s
- Review stress analysis

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Account for the Well’s Slump

- Well finds a new equilibrium
- Significant load changes
- May still be within limits
- If slumped distance not known assume next string in is now structural.

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External load sources

- Conductor supported wells
- Include wave & current loading
- Insert corroded section/s, define guides & clearance, soils
- Well loads from static applied as distributed axial load in dynamic global model.
Operational load sources

- Weight of surface equipment – full stack up.
- Thermal changes not to be underestimated! Any cold injections in particular

All future lifecycle operations considered through to abandonment

Well kill operation adding 100 Te!

<table>
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<tr>
<th>Load</th>
<th>Axial Load (tonne)</th>
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<tr>
<td></td>
<td>30&quot; Conductor</td>
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<td>Primary Cementing - 20in x ... Surface Casing</td>
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<td>Nipple-Up BOP - 20in x ... Surface Casing</td>
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<td>Primary Cementing - 10 3/4in x 10&quot; Production Casing</td>
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<tr>
<td>Primary Cementing - 8.312in x ... Production Liner</td>
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<tr>
<td>Primary Cementing - 7in x 5 1/2&quot; Production Tubing</td>
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<tr>
<td>Nipple-down BOP - 7in x 5 1/2&quot; Production Tubing</td>
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<tr>
<td>P.6 End Cold Kill Early - 7in x 5 1/2&quot; Production Tubin</td>
<td>-913.7673</td>
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Well Condition Known - Remediation Methods
STEP 4. Corrective/Preventative Methods

Low Severity

- Baseline PEC wall thickness & revisit at later date, corrosion problems not always obvious.

- Corrosion inhibition
  - Rapeseed oil top up (N.Sea)
  - Biocide
  - Coatings

- Measure & record GAP and Wellhead elevation for significant events.
STEP 4. Corrective/Preventative Methods

Medium Severity

- **Stabilisation**
  - Conductor guide reinstatement
  - Conductor & surface casing retro-fit centralisers
  - Increases fatigue life & reduces VME stress

Conductor guide installation - Claxton

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STEP 4. Corrective/Preventative Methods

Medium Severity

- Load transfer using shims/clamp
  - Conductor integrity?
  - Soil integrity?
  - D-Annulus access preserved

- Grouting D-Annulus
  - Floating grout retainer for holed conductors
  - Access to D-Annulus lost
  - Corrosion inhibition over grouted interval
  - Hot or cold?
  - Restricting its movement not necessarily a good thing!

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STEP 4. Corrective/Preventative Methods

Short term solutions

- Platform Supported
  - No conductor integrity required
  - Platform strength – limited number of wells
  - Ideal for abandonment
  - Ideal to support well for repair work

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STEP 4. Corrective/Preventative Methods

- Reinforcing Conductors / Casings
  - Complex
  - Well supported / lifted during repair

- Replacement
  - Full well integrity restored
  - Very complex

High Severity

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Summary

- Investigate your wells
- Identify and repair critical wells APPROPRIATELY & COST EFFECTIVELY.
- Prevent FURTHER CASULATIES
- Monitor

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Conclusion

- The well model is invaluable to predict problems and catch the wells EARLY...$$$. 

- Generic studies on analogous wells increases efficiency.

- Well movement measurements during intervention & operations are invaluable. Is it moving as it should?

- Accuracy of the analysis - isolates ONLY the wells requiring attention & defines the optimum solution.

- The wrong fix can cause other failures but if it’s not broken – don’t fix it!

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Questions?
Thank you