Managing Integrity Status for Large Well Stocks

M.C. Fatah & A.C. Spowage

Subsea Asia 2015 Conference
23-24th November 2015
Jakarta, Indonesia
Outline

• Well Integrity
• Large Well Stocks
• Conclusion
What is well integrity?

• Application of technical, operational & organizational solutions to reduce risk of uncontrolled release of formation fluids throughout the life cycle of a well.

• In the real world:
  • To ensure that the well is safe
  • To ensure the well is available for production
  • To optimise production rates, and
  • To minimise total costs
Integrity in wells vs other asset types

• They are complex multi materials, multi dimensional structure
• They are exposed to a range of harsh, changing environments
• They may have over 2000 Components
• They may extend several km into the ground, both vertical and horizontal sections, and
• Occluded Structures

‘We’re going to need a bigger rug or we’re sunk.’
Why is Well Integrity important?

Catastrophic consequences of well failure

If we assume that the average percentage of shut in wells is 19% then the estimated global cost of well integrity issues is:

> US$ 1 Billion Per Day
Well Integrity Issues

In mature fields, approximately half of all workovers are related to WI problems.

Wellhead movement
Surface casing corrosion
Corrosion tubing string
Build up scale

Valve and seal leak
ScSSV and control line issue
SAP burst casing
Cement durability
How common are well integrity issues?

Wells worldwide affected by integrity issues
~750,000

Gulf of Mexico
(45%, 6,650 wells of 12,927)
Sustained Annulus Pressure

North Sea, UK
(34%, 1,600 of 4,700 wells)
At least one anomaly

North Sea, Norway
(18%, 482 of 2,682 wells)
One or more integrity failure

REF: SPE forum North Sea Well Integrity Challenges, 2009.
Challenges with large well stocks

- Large amounts of historical data
- Chasing data updates
- Multiple platforms, fields, countries
- Application of rules to a huge dataset in every reporting period
- Generating reports specific to stakeholder needs
- Differing regulatory requirements
- Prioritising actions with limited resource
- Planning CM / PM, interventions etc

Leads to Firefighting Rather than
“Looking after what is important.....!!”
Tools to manage large well stocks

• A comprehensive Well Integrity Management System (WIMS)

• Specific tools which can assist:
  ➢ Well Failure Action Matrix (WFAM)
  ➢ String Status Reporting
Well Integrity Management

• Fundamentals: ability to identify and categorise the integrity status of a well.

• A clearly written set of documentation is needed: WIMM (well integrity management manual).
  - Reference document to ensure adequate and sufficient of well integrity standard is applied.
  - Outline the expectations of life cycle management of well integrity.
  - Identify the roles and responsibilities of personnel for delivering well integrity assurance.
  - Functioning as a high level bridging document.
Well Failure Action Matrix

• A tool for distilling the following and integrating into the COMPANY WIMS:
  ➢ National Regulations
  ➢ International Standards (e.g. NORSOK D-10, API RP14B)
  ➢ COMPANY specific standard / best practices, and
  ➢ External & Internal expertise

• Generates a set of well stock specific rules

• Once data is applied the outputs are:
  ➢ Status of each safety critical element
  ➢ Overall well integrity status, and
  ➢ Decisions on what action needs to be taken
## Simplified Well Failure Matrix example

<table>
<thead>
<tr>
<th>Risk Factors / Well Type</th>
<th>Gas Injector</th>
<th>Artificial Lift Well</th>
<th>Gas Producer</th>
<th>Oil Producer</th>
<th>Water Injector</th>
<th>Subsea Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>External leak from x-mass tree or wellhead</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>SCSSV and SSV/Upper Master Valve Failure</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>SCSSV Failure</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Packer Plug Failure</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Valve test degraded</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Well with the status of 1, 2, 3 (healthy); 4 & 5 (unhealthy)
## Simplified Action Matrix example

<table>
<thead>
<tr>
<th>Failure Status</th>
<th>Required Action</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Risk 1&amp;2</td>
<td>The well can be operated in this condition.</td>
<td>Continue to check, test, monitor and maintain</td>
</tr>
<tr>
<td>Medium Risk 3</td>
<td>The well can be operated in this condition.</td>
<td>Enhanced monitoring of degraded component, life time modelling and replacement planning.</td>
</tr>
<tr>
<td>Higher Risk 4</td>
<td>A dispensation is required to operate during this period. If the dispensation is not granted then the well needs to be made safe and secure immediately.</td>
<td>Immediate technical review to determine mitigating actions. A dispensation must be obtained to operate but limited to only X month. Repairs to be done on urgent basis within Y month.</td>
</tr>
<tr>
<td>Higher Risk 5</td>
<td>Make well safe and secure immediately.</td>
<td>Immediately secure well and make it safe. Implement well integrity corrective actions. Repairs to be done on a critical basis.</td>
</tr>
<tr>
<td></td>
<td>Operation under dispensation is NOT allowed.</td>
<td></td>
</tr>
</tbody>
</table>
IWIT®: Key features of a comprehensive WIMS

- Capture your data
  - Manual (spreadsheets)
  - Automated / Interfaced (iWIT NotePad)
- Store all data in a single database
- Access to data
  - from any computer
  - by anyone (with authorisation)
  - from anywhere; anytime
- Visualise your data
- Analyse your data
- Determine well integrity status

- Evaluates
  - Well diagnostic status
  - Monitors Annulus-pressure
  - Diagnostic test data
  - ID’s sustained annulus pressure source and cause
  - Tubing corrosion rate
  - Determines erosion rate due to sand production
  - Remaining tubing life
- Customised reporting
- Predictive tools
- Investigation tools
- Combine your data with rules
- Real Time Status, and
- Fully configurable
Allows reporting at multiple levels
String Status Reporting

• Based on well classification from an expanded WFAM

• Example of information contain in string status report:
  ➢ Current Well status: Healthy/Unhealthy
  ➢ Current Unhealthy status: Baseline/Emerging
  ➢ Monthly: Healthy/Unhealthy / Emerging Reports
  ➢ Rectified category: Baseline/Emerging
  ➢ Well Category: Flowing/Closed in
  ➢ Unhealthy classification: Effective/Non-Effective/Depleted/NA
  ➢ Unhealthy sub-classification: ECH/OPS/AI/RMD/FAC/RM/LMT
  ➢ Estimated BOPD
String Status Reporting

With IWIT® string status report….

• Helps to effectively manage the well data
• Automated data collection
• Automated well classification
• Automated recommendation actions
• Pre-populated data forms which make status and action decisions more efficient
• Decision points are highlight changes in status for review by WI engineers
• Customized report which viewing across well integrity categories and the interrogation of issues, data and other statistics
String Status Reporting - Filtering

Filter criteria:
- Well hierarchy level (country, area, field and platform).
- Type of the well.
- Well status category (healthy or unhealthy).
- Month.
- Well location.
- String type (long or short).
String Status Reporting

Developed based on the filter criteria selected

Click on the “box” for category detail
Conclusion

• Well integrity often gets overlooked yet it is a crucial to prevent the worst types of incident experienced in our industry.

• An integrated enterprise wide Well Integrity Management System is essential provides:
  - Visibility of Risk
  - Enhanced Management of Risk
  - Enhances production
  - Allows optimisation of costs
  - Enables automated assignment of well classifications
  - Facilitates management of large volumes of historical data
  - Facilitate investigation of issues
  - Provides automation in reporting, data collection, status assignment, work orders

• Within a WIMS, the WFAM & string status reporting tools have been particularly effective in managing large well stocks.
Thank You
ScSSV Allowable Limit of Leak Rates

For gas wells: 15 SCF/min
For oil wells: 400 cm³/min

<table>
<thead>
<tr>
<th>Well Type/ Tubing Size</th>
<th>Allowable Pressure Build Up in 15 Minutes (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-3/8”</td>
</tr>
<tr>
<td>Oil Producer/Water Injector</td>
<td>315</td>
</tr>
<tr>
<td>Gas Producer/Water Injector</td>
<td>210</td>
</tr>
</tbody>
</table>

Ref: API RP 14B, Recommended Practice for Design, Installation, and Operation Subsurface Safety Valve System