Panna-Mukta-Tapti Well Integrity Management System During Operating Phase

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Outline

– What Is Well Integrity
– Consequences
– Well Life Cycle
– Field Overview
– Barriers
– Well Integrity Management System Development Process
– Roles, Responsibilities and Accountabilities
– Managing Safety Critical Elements
– Well Integrity Matrix
– Actions Following Failures of SCE
– Review & Visibility Of Well Integrity
– Challenges
– Conclusions
What Is Well Integrity

- Every well is designed with certain barriers to prevent uncontrolled hydrocarbon flow to atmosphere
- Integrity of these barriers is essential to ensure safety of the well
- Loss of barriers leads to loss of well integrity

Well integrity is the quality or condition of a well being structurally sound

Sources: NORSOK STANDARD D-010 -Well integrity in drilling and well operations
Consequences

Potential risk of uncontrolled hydrocarbon flow leading to

- Environmental damage
- Asset damage
- Loss of multiple lives
- Business disruption
- Recovery cost
- Company’s reputation

Sources: http://www.wellintegrity.net/
http://blogs.ft.com/energy-source/
http://theenergycollective.com
http://en.wikipedia.org/wiki/Deepwater_Horizon_oil_spill
Well Life Cycle

- Design
- Construction
- Operation (Production, interventions)
- Abandonment

- Longest Phase
- Focus of discussion on production
Field Overview

<table>
<thead>
<tr>
<th></th>
<th>Panna-Mukta</th>
<th>Tapti</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from Mumbai</td>
<td>95 KM</td>
<td>160 KM</td>
</tr>
<tr>
<td>Platforms</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Wells</td>
<td>130</td>
<td>36</td>
</tr>
<tr>
<td>Producing Since</td>
<td>1986 (26 years)</td>
<td>1996 (16 years)</td>
</tr>
</tbody>
</table>
Barriers

• At all times there shall be two independent barriers in each flow path between hydrocarbon bearing permeable zones and surface.

• During normal operating conditions, one of these barriers shall be below the seabed/ground level.

• The types of barrier shall be appropriate to the flow path, the future utilisation and the extended life of the well.

• Examples of Well Barriers
  – A casing string properly cemented in place to seal off formation pressure and prevent flow into the wellbore.
  – Christmas tree and components of the wellhead assembly for controlling and blocking pressure and flow from the well.
  – Completion equipment i.e. subsurface safety valve, packer, etc.

Sources: NORSOK STANDARD D-010 -Well integrity in drilling and well operations
Well Integrity Management System (WIMS) Development Process

- Review well design & identify leak paths
- Assess Risk & identify Safety Critical Elements (SCE)
- Define performance standards, inspection/maintenance frequencies and acceptance criteria
- Develop Level 2 document for maintenance and inspections of SCEs
- Assign roles & responsibilities
- Implement WIMS
- Roll out WIMS
- Revise WIMS based on Audit observations/learning during implementation
- Carry out audit after one year

PMT Joint Venture (Operated by ONGC, RIL and BGEPI)
Managing Safety Critical Elements:
Down Hole Safety Valves

Function: Sub surface barrier to prevent uncontrolled hydrocarbon flow in the event of catastrophic failure of wellhead/x-mas tree

Test Frequency
- Panna-Mukta: 6 months
- Tapti: 9 months

Acceptance Criteria
- API – 14B
  - Liquid test: 400 cc/min
  - Gas test: 15 scf/min (15 m3/hr)

Sources: Panna Mukta & Tapti Well Integrity Management System document
Managing Safety Critical Elements:
X-Mas Tree & Wellhead Valves

- **Function**: Primary surface barrier to prevent uncontrolled hydrocarbon flow during production

### Maintenance

- **Greasing**
  - Panna-Mukta: 6 months
  - Tapti: 9 months

### Inspection

- **Frequency**
  - Panna-Mukta: 6 months
  - Tapti: 9 months

- **Manual Valves**
  - Opening/closing: No of turns
- **Actuated Valves**
  - Opening/closing time of 6-8 seconds

### Testing

- **Frequency**
  - Panna-Mukta: 6 months
  - Tapti: 9 months

- **Acceptance Criteria**
  - API – 6A
  - Liquid test: 400 cc/min
  - Gas test: 15 scf/min (15 m³/hr)

Sources: Panna Mukta & Tapti Well Integrity Management System document
Managing Safety Critical Elements: Casing Annuli

Legend
PDMS: Production Data Management System
MAASP: Max Allowable Annulus Surface Pressure

Monitoring
- A, B & C Annulus Monitoring
  All wells: Fortnightly
- A Annulus Inflow test
  Gas lift wells: Annual

Review
- Data captured in PDMS
- Over 200 psi change generates mail notifications
- Pressure below MAASP#
- Pressure bleed off follows to establish if annuli pressure is of sustained nature
- Systematic decision tree used to diagnose leak and secure well

Follow up action
- If Sustained casing Pressure is established
  * Shut the well
  * Carry out diagnostics to locate leak source
  * Rectify the leak
  * If not feasible, secure the well & plan for work over

# MAASP values revised annually

Sources: Panna Mukta & Tapri Well Integrity Management System document
Managing Safety Critical Elements: Casing Annuli

PMT Joint Venture
(Operated by ONGC, RIL and BGEPIL)

Daily monitoring and recording of annulus pressures

Pressure Anomaly?

Yes

Above MAOP?

Yes

Inform Well Integrity Engineer

Analyse Data

Assess Risk. Evaluate Actions. Obtain Dispensation (if flow is to continue).

Make Well Safe

Implement Remediation Programme

No

Bleed Down and Monitor

Obtain Sample

Unable to Bleed Down or Builds Up Quickly

Yes

Inform Well Integrity Engineer

Analyze Data

Assess risk. Evaluate actions.

Make Well Safe

No

More than one Annuli Affected?

Yes

Obtain Sample

Inform Well Integrity Engineer

Analyze Data

Assess risk. Evaluate actions.

Make Well Safe

No

Inform Well Integrity Engineer

Analyze Data

Assess risk. Evaluate actions.

Make Well Safe

Sources: Panna Mukta & Tapli Well Integrity Management System document
Managing Safety Critical Elements: Wellhead & Tubing Hanger Seals

**Testing**
- Panna-Mukta: 12 months
- Tapti: 12 months

**Acceptance Criteria**
- Zero leak

**Follow up action**
- Assess risk and shut the well if communication to casing established
- Carry out diagnostics to locate leak source
- Rectify the leak or secure the well

Sources: Panna Mukta & Tapti Well Integrity Management System document
## Well Integrity Matrix Example

### Table: Well Integrity Matrix

<table>
<thead>
<tr>
<th>VALVE</th>
<th>Test Frequency</th>
<th>Failure Mode</th>
<th>Single Valve Failed</th>
<th>SV</th>
<th>A-UMV</th>
<th>A-WV</th>
<th>LMV</th>
<th>SCSSSV</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV</td>
<td>6 Month</td>
<td>Leak in Closed Position</td>
<td>Continue production. Repair within 6 months</td>
<td></td>
<td>Continue production. Repair within 3 months.</td>
<td>Continue production. Repair within 3 months.</td>
<td></td>
<td>Continue production. Repair within 3 months.</td>
</tr>
<tr>
<td>A-UMV</td>
<td>6 Month</td>
<td>Leak in Closed Position</td>
<td>Continue production. Repair within 6 months</td>
<td></td>
<td></td>
<td>Shut-in until repair</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-WV</td>
<td>6 Month</td>
<td>Leak in Closed Position</td>
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<td>LMV</td>
<td>6 Month</td>
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<td></td>
<td>Continue production. Repair within 3 months.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>SCSSSV</td>
<td>6 Month</td>
<td>Leak in Closed Position</td>
<td>Continue production. Repair within 3 months.</td>
<td></td>
<td>Shut-in until repair</td>
<td>Shut-in until repair</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any External Leak</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Risk Assess and Shut-in until repair</td>
</tr>
</tbody>
</table>

Sources: Panna Mukta & Tapri Well Integrity Management System document

The Matrix ensures that we always have minimum two barriers to allow safe production.
Actions Following Potential Failures of SCE

- SCE inspection/testing data reviewed by Well Integrity Engineer
- Anomalies analyzed
- Decision made to shut well as per well integrity matrix
- Diagnostics plan prepared and discussed with stakeholders
- Priorities agreed based on level of risk
- Interventions scheduled in Asset’s Integrated Plan
- Interventions carried out and well brought back on production or secured till work over is planned
Innovations For Improving Well Integrity

• Capillary safety Valves – alternate to failed down hole safety valve

• Specialized valve grease – to provide seal to passing x-mas tree/wellhead valves

• Down hole safety valve control line and wellhead seal leak repair

• Well integrity database management software

• Specialized acid Spotting Tool - Restoring functionality of scale down hole safety valves
Review & Visibility Of Well Integrity

• Review of incoming data by Well Integrity Engineer - daily
• Review of well integrity status with platform Management – monthly
• Issue of monthly well integrity report to stakeholders in Asset
• Inclusion of well integrity KPIs in Asset Integrity Scorecard
• Review of well integrity status by Asset HSSE Committee chaired by MD PMT with focus on high risk wells action plan - monthly
• Issue of Quarterly & Annual report on well integrity status
Well Integrity Data Management

- iWIT software is used for well integrity management and reporting
- Web based software with connectivity to PDMS for live annuli data feed
- SCE inspection/testing data manually entered
- MAASP data manually entered
- Gives live status of well integrity - Red Flags for affected wells
- Can generate inspection/testing reminders

Sources: Panna Mukta & Tapti well integrity database
Challenges

• Aging wells - up to 25 years old
• Large well stock of 166 wells
• Wells drilled by various operators over last 25 years – different SCE designs
  – Stacked wellheads
  – TRSV & control line seals
  – Non-premium production casing
  – Storm Chokes
  – Wellhead side outlet configurations
Conclusions

• Well Integrity management during operation phase is essential to ensure safe and uninterrupted production

• Well Integrity management becomes far more challenging in matured assets and aging effect

• Successful well integrity management depends on:
  – A risk based documented well integrity management system
  – Availability of a dedicated well integrity engineer
  – Clearly defined roles and responsibilities of stakeholders
  – Visibility and sensitivity of well integrity in the asset management team
  – Focus on managing Well Integrity at par with Asset Integrity
THANKS FOR YOUR ATTENTION!
Leak Path Diagram

Leak paths can be managed by managing various Safety Critical Elements.

Sources: Panna Mukta & Tapti Well Integrity Management System document
Safety Critical Elements

- Down Hole Safety Valves
- X-Mas Tree & Wellhead Valves
- Casing Annuli
- Wellhead & Tubing Hanger Seals
Responsibilities For Well Integrity

PMT Joint Venture
(Operated by ONGC, RIL and BGEPIL)

Vice President - PMT

Well Engineering Manager

Completion Team Leader

Address completion issues

Well Service Manager

Monitor, review, report

Independent Competent Person

Well Integrity Engineer

Review/Audit

OIM

Production Supervisor / Platform In Charge

Inspection/testing SCE