PERFORATING ISSUES - LESSONS LEARNED

MENAPS 16-23

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INTRODUCTION

Perforation Operations problems _ Case history

- Perforations shots expired/ offdepth _ WRFM
- High shot density in unstable sand stones _ FDP
- Guns stuck in X-mass tree _ Isolation _ HSE
Expired Gun Shots (WRFM)

- Valid shots manufacturing date
- Retrieved Guns showing all shots fired
- Pressure at well heads indicate firing
- Sounds recorded firing echo
- Flowing the well and testing proves inflow _ but LOW.

- Logs proven HC exists & rock quality.
- Offset wells resulted in good potential.

- Guns shots quality? or Off depth Perforations? or Both?

Problem – Mitigations – Solutions

Re-perforation same gun design, same intervals = Inflow improvement
Off depth perforations (WRFM)

- Perforate off depth
  - High water production
  - Capex lost
  - Confusion on field development
  - People time
  - Resources to Fix the problem

Remedial action

20 m3/d oil gain
Perforations Design _ Flow Assurance & Wells LOP (FDP)

- Sand stone _Consolidated & Non-consolidated
- Consolidated sand could be unstable.
- Rig activities impacting area around wellbore.
- Sand control at DH _ Chemical or Mechanical
- Casing cementing is a mech. sand protection in unstable sands.
- Rock data, pressures, temp, depth and inflow are affecting guns design.

- Use 12 SPF or 5 SPF, how this impacting area around well bore and sand barriers?

- Old perforations schools.
- Pressure UB.
- Clean perforations.

- Criteria of perforations success...... Inflow _ Solids control
## Perforations Design Impacts on Flow Assurance & Wells LOP (FDP)

<table>
<thead>
<tr>
<th>Year</th>
<th>TCP Jobs</th>
<th>12 SPF</th>
<th>5 SPF</th>
<th>12 SPF (%)</th>
<th>Pump RLT/ y</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>2008</td>
<td>51</td>
<td>5</td>
<td>46</td>
<td>10</td>
<td>3</td>
<td># of wells 1300</td>
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<tr>
<td>2009</td>
<td>88</td>
<td>60</td>
<td>28</td>
<td>68</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>72</td>
<td>37</td>
<td>35</td>
<td>51</td>
<td>2</td>
<td>Different material sources</td>
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<tr>
<td>2011</td>
<td>39</td>
<td>27</td>
<td>12</td>
<td>69</td>
<td>2 - 1.5</td>
<td>Start use high UB pressure</td>
</tr>
<tr>
<td>2012</td>
<td>42</td>
<td>28</td>
<td>14</td>
<td>67</td>
<td>2 – 1.5</td>
<td></td>
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<tr>
<td>2013</td>
<td>44</td>
<td>26</td>
<td>18</td>
<td>59</td>
<td>1.5 - 1</td>
<td></td>
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<tr>
<td>2014</td>
<td>53</td>
<td>39</td>
<td>14</td>
<td>74</td>
<td>1.5 - 1</td>
<td>Less attention to pres DD</td>
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<tr>
<td>2015</td>
<td>56</td>
<td>43</td>
<td>13</td>
<td>77</td>
<td>1.5 - 1</td>
<td>Material sources</td>
</tr>
<tr>
<td>2016</td>
<td>52</td>
<td>42</td>
<td>10</td>
<td>81</td>
<td>1.5 - 1</td>
<td># of wells 2000+</td>
</tr>
</tbody>
</table>
Guns stuck in X-mass tree — Isolation (HSE)

- Gas application
- 24 workers on un-manned 16 slots prod. satellite
- Communications!
- Nearest Supply Boat at 4 sea miles
- Wire line guns
- Rig UP & Start Run in Hole
- Detonator activated
- Gun stuck in X-mass tree at 1.2 m?

Unwanted situation
Guns stuck in X-mass tree _ Isolation (HSE)

- People Safety first
- Failure HSE instructions (LSR)
- Investigations
- Detecting reasons _ Missing HSE instructions.

- Actions _ Success
- Power of WIT and wells maintenance
- SCSSV is the secret word.

- Disconnect guns detonators

- Call for help
- Retrieved Guns safely
- R/D _______________________________ Nov_1988
QUESTIONS?
THANK YOU!