Ball Seat Milling using Electric Wireline

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Overview

• Agenda
  – Introduce Welltec
  – Milling Ball Seats on Electric Wireline
    • Why
    • Bit selection/ design
    • Rotary tool/ Bottom hole assembly
    • Surface trials
    • Lessons learned
    • Operational success
  – Open Discussion
Welltec® is a global oilfield solution provider with the majority of its products designed, manufactured and tested in-house at the Corporate Headquarters in Denmark.

Provides R&D, Design, Manufacture, Service, Products and Solutions.
Product Family

- Well Conveyance Services
- Well Mechanical Intervention
- Well Subsea Intervention
- Well Completion Products
- Well Imaging & Measurement
What is a Ball Seat?

Profile in each stage of a multi zone frac
As frac'ing occurs, a ball is dropped
The ball seats into this profile and:
• Isolates the frac interval below
• Slides a sleeve to open the next frac stage
Why remove Ball Seats?

• To increase production flow area
• To remove blockages/ potential debris
• To enable future interventions:
  • Production logging
  • Perforating
  • Diagnostic camera services
  • Casing patch
How are they currently removed?

• Coiled tubing with milling bit
• Jointed pipe – Service or Drilling rig
  • Heavy/Costly equipment
  • Fluid driven bits
• Equipment be better used for other services such as drilling/ stimulating wells
Why using Wireline?

• Reduce intervention costs
• Fluid sensitive formation
• Coil/Rigs could be better used elsewhere
• Grease injector friendly (wireline)
• Accomplish multiple interventions while onsite:
  • Production logging
  • Perforating
  • Diagnostic camera services
  • Casing patch
Preliminary solution considerations

- Weight on bit
- Rotary force
- Bit design
- Cuttings handling
- Potential debris/frac sand
- Cost
Milling Bit Design

- Initial surface trials were using a “conventional” Welltec Scale Milling Bit

- Tungsten Carbide teeth on tapered mill

- We created increased performance by adding deeper sidewall, and teeth to side
Weight on Bit

- Provide conveyance in high angle
- Provide weight on bit while milling
- Provide anti-rotation while milling
Rotational Force

- Electric rotational device
- Hydraulic fluid compensated
- Adjustable gear ratio for milling purpose
Debris Handling

Power Suction Tool®

• Downhole debris removal device
• Can remove produced sand, frac sand, scale, cement
Debris Handling

Power Suction Tool®
Surface Trials

Ball Seat milling trials held in:

- Calgary
- Houston
- Aleroed
Surface Trials

Milled a variety of styles and sizes:

**Packers Plus**
- Ball seats
- Repeater sub

**Baker**
- Ball seats

**Peak**
- Ball seats
Summary of Results from Testing

• A total of 20 ball seats of various company design, size and material have been milled at surface

• The ball seats were milled in varied stages, with frac ball in place, and without

• The quickest ball seat milling took 6 minutes, with the longest taking 20 minutes

• Post milling debris is minimal
Summary of Lessons Learned

• Bit design modification enabled higher performance

• Use of additional wheel sections in Well Tractor to provide sufficient power, speed and push force

• Use of Wireline tension, to maintain a controlled weight on bit

• Debris appeared to not be of concern in milling process

• Milling “untouched” ball seats is preferred

• Confirm bottom hole assemblies – bent tubing joints for multilateral well orientation can prove challenging
Case Study

- North sea operator had a ball and seat to remove from well as a part of workover to reduce restrictions in the well for further intervention

- Alternatives were considered, but ultimately the operator selected to utilize a lightweight intervention of wireline with Well Tractor and Milling solution

- Total intervention offshore took 13 hours from rig up to rig down, with a milling time of 15 minutes

- Well depth 3,800m MD
Surface trials, successful interventions and development from lessons learned have proven that Wireline technology can provide alternatives to conventional milling operations.
Thank You