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

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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.

Geographic Footprint

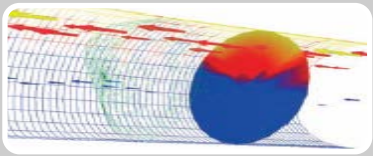
Product Family

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 fraccing 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?

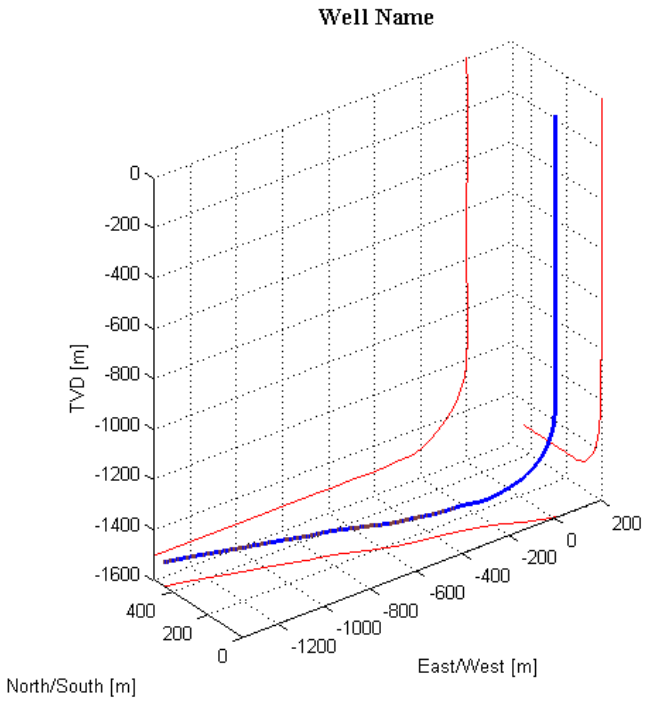
- Coiled tubing with milling bit
- Jointed pipe – Service or Drilling rig
  - Heavy/Costly equipment
  - Fluid driven bits
  - Equipment be better used for other services such as drilling/ stimulating wells

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

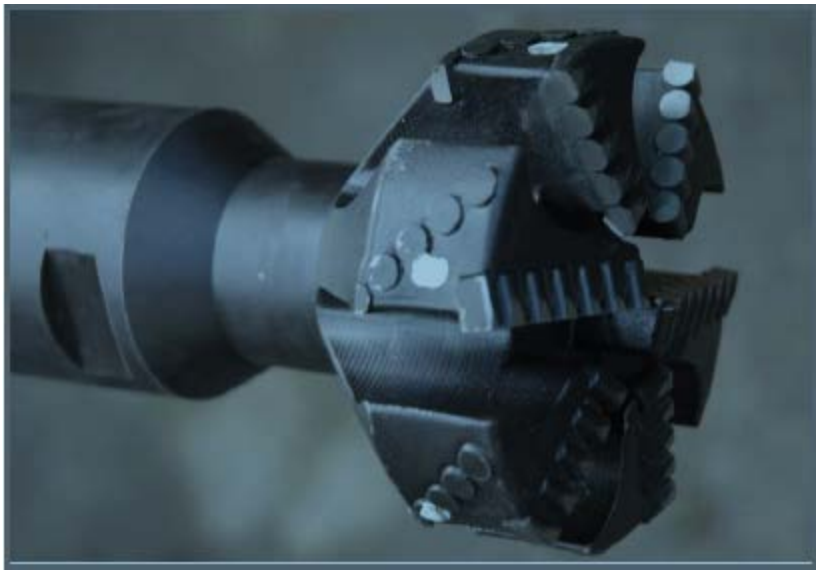
Preliminary solution considerations

- 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

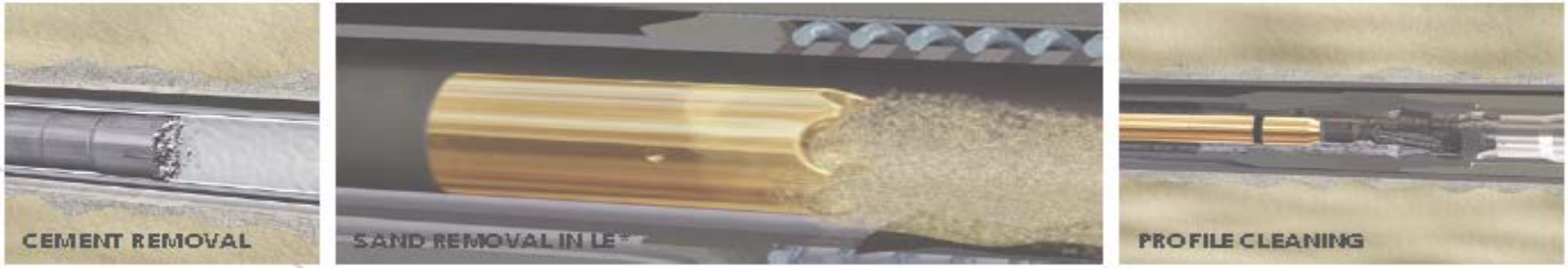
- Provide conveyance in high angle
- Provide weight on bit while milling
- Provide anti-rotation while milling

Rotational Force

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

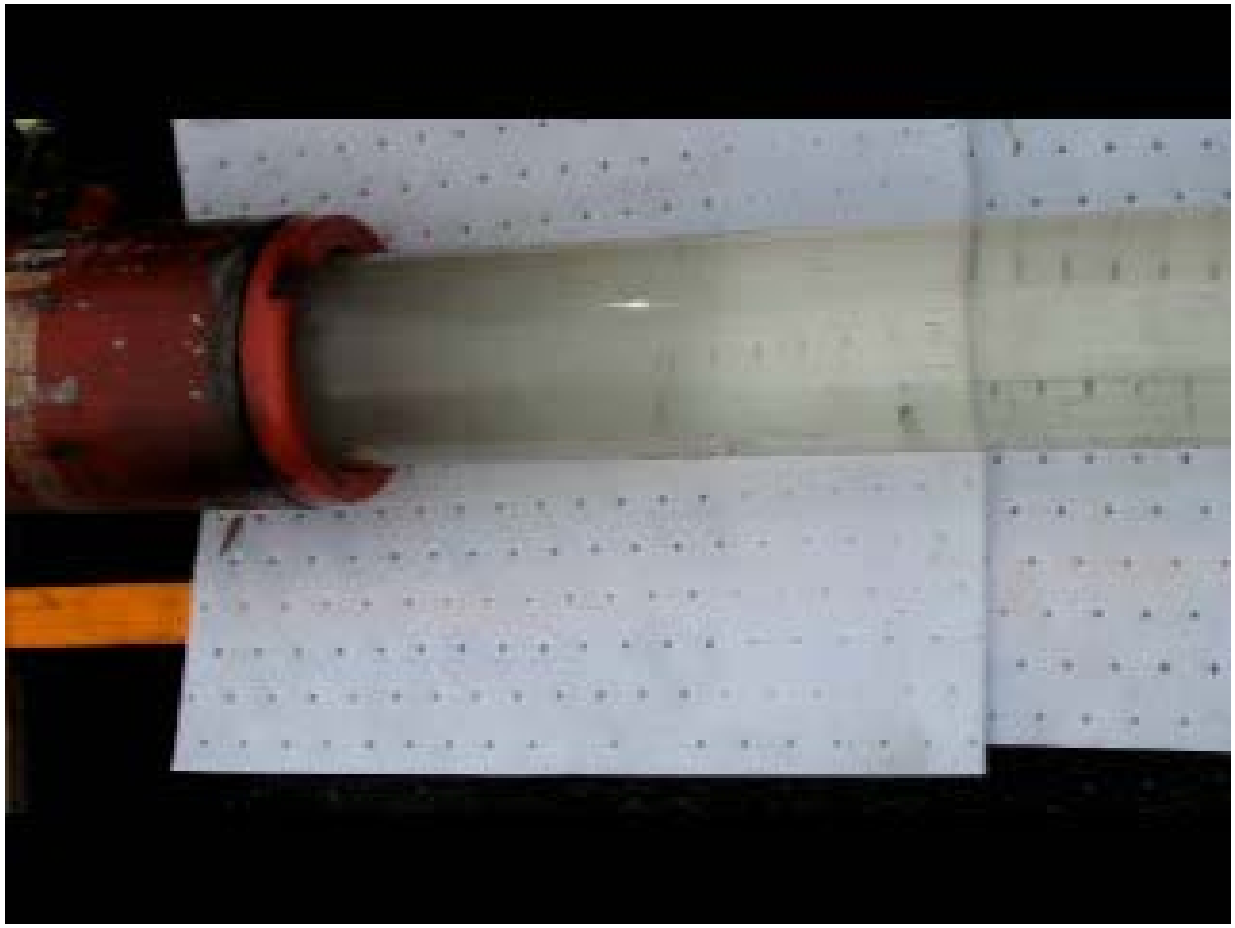
Debris Handling

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

Conclusion

Surface trials, successful interventions and development from lessons learned have proven that Wireline technology can provide alternatives to conventional milling operations.

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Thank You





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