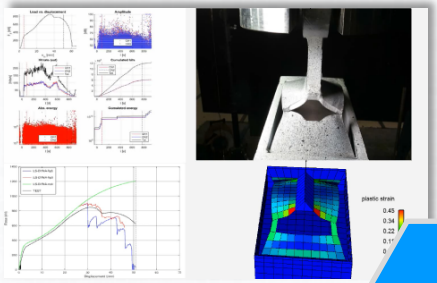
Marcus Hall & Björn Ullbrand

Alexander Lucas

The use of advanced Computational Fluid Dynamics modelling to optimise Perforate, Wash and Cement job hydraulics and improve cement plug barrier quality



Risers & Wellheads

Fatigue damage, loads from workover and completion

Simulation methodology & software development

Jackets & Monopiles

ULS, FLS, SLS, ALS

Validus engineering

Simulation portfolio

Casing Operations

Cutting, pullout, collapse

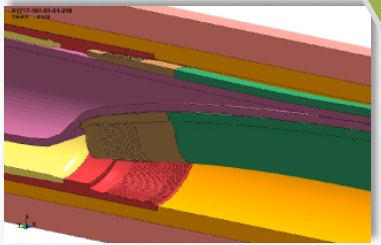
Wave loading simulations

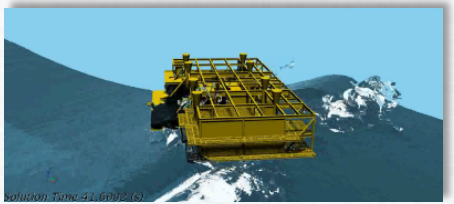
Rogue waves, slamming

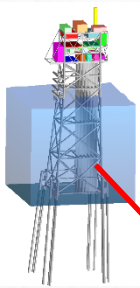
P&A

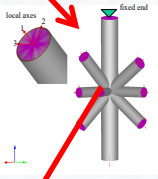
PWC

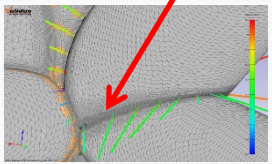
DHT











SPE International
Aberdeen Section
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Optimising PWC with CFD - washing

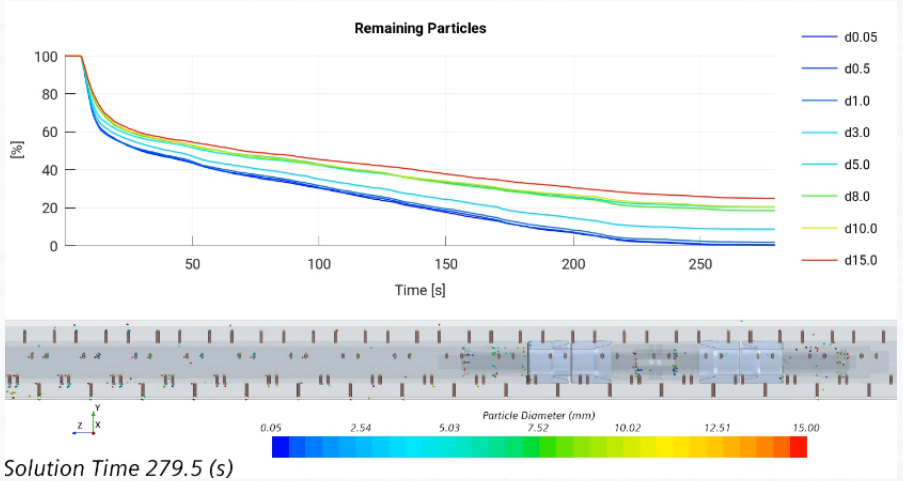
Tools
- Tool comparison
- Tool optimisation
- Optimise operational parameters

Washing rheology
- Shear thinning behaviour of mud
- Lifting performance vs flow rate

Perforation pattern
- Choose preferable perf pattern
- Effects of unperforated sections
- Pressure drop / formation pressure

Annulus material
- Barite
- Particulate matter
- Hydrocarbons

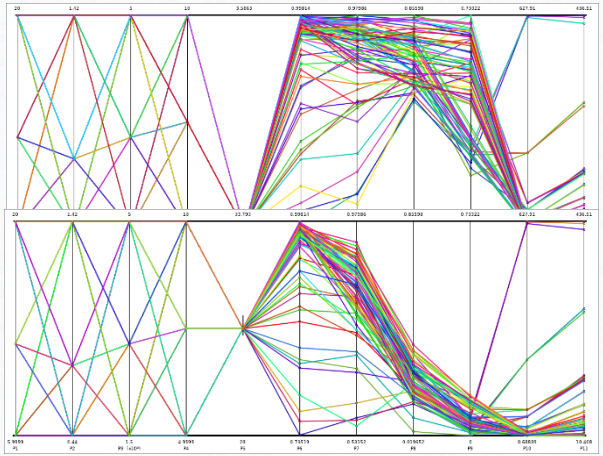
Real life configs
- Ratholes
- Dual casings
- Bore inclination
- Concentric vs offset casing/tubing

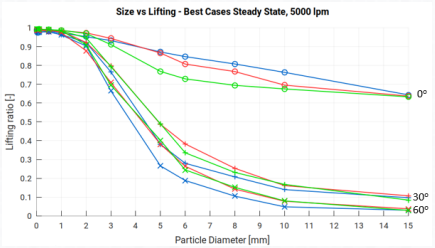


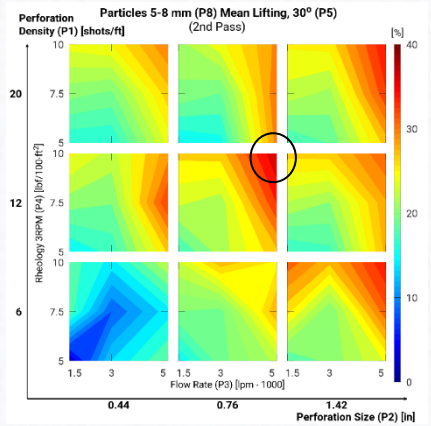
Archer

Picture showing Archer Stronghold® Barricade®

Optimising PWC with CFD - washing







300 CFD simulations varying:

- Perforation density
- Perforation size
- Flow rate
- Rheology
- Inclination

Evaluated according to:

- Lifting performance x4 sizes
- Pressure requirement
- Perf flow velocity

TOTAL Guideline
&
Best practises

for washing, optimised operational procedures

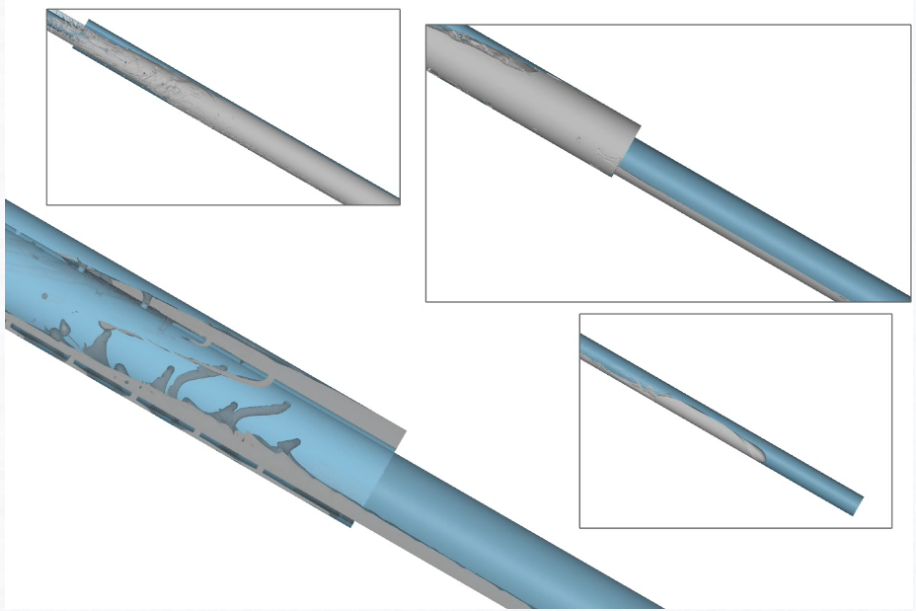
Optimising PWC with CFD - cementing

Tools
- Tool comparison
- Tool optimisation
- Optimise operational parameters

Cement properties
- Contamination / mixing
- Rheology
- Density
- Spacer

Perforation pattern
- Choose preferable perf pattern

Real life configs
- Ratholes
- Dual casings/annuli
- Slumping
- Concentric vs offset casing/tubing



Archer

Picture showing Archer Stronghold® Barricade®

Optimising PWC with CFD - cementing

Tools
- Tool comparison
- Tool optimisation
- Optimise operational parameters

Cement properties
- Contamination / mixing
- Rheology
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Perforation pattern
- Choose preferable perf pattern

Real life configs
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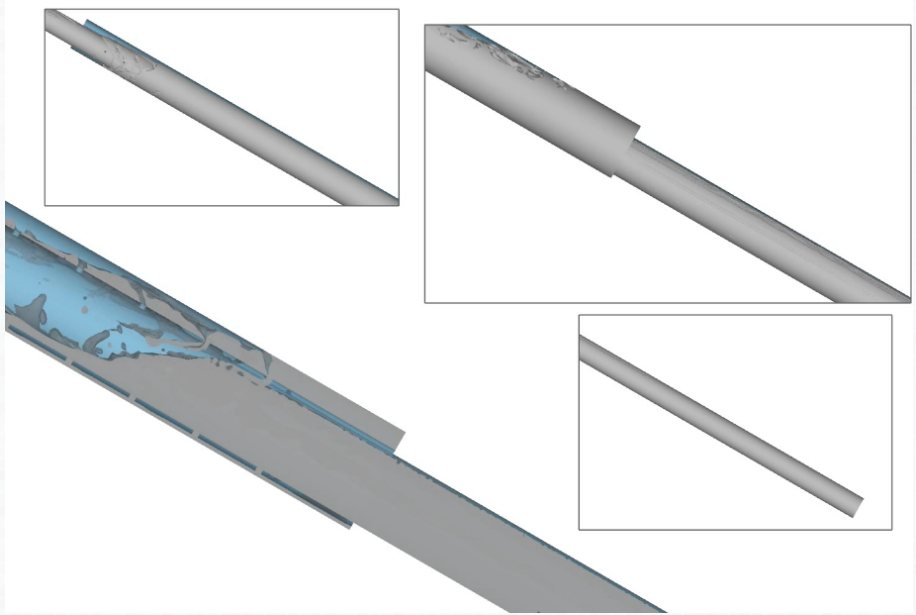

TOTAL Guideline:
Best practises for cementing, optimised operational procedures

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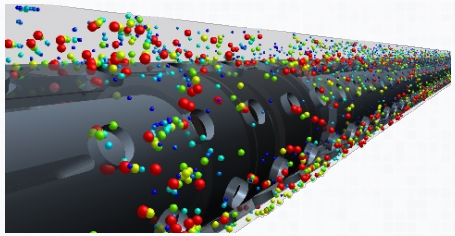
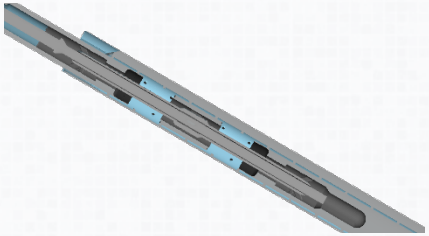
CFD for PWC - Final remarks





Validus engineering
Simulation specialists

P&A
PWC
DHT

- Extensive CFD study conducted for Total to optimise parameters for best practices & guidelines.
- Analysed multiple tools and procedures for special well configurations and challenging situations (through-tubing, Coiled Tubing, slumping, dual casings).
- Provide assurance to both operators and regulatory authorities for best practices and appropriate design for long-term barrier integrity & quality.
- Assist service providers to demonstrate their solution is optimal for the P&A challenge in question.