P&A Operations and Technology on Well Cross-Sectional Barriers and Slot Recovery

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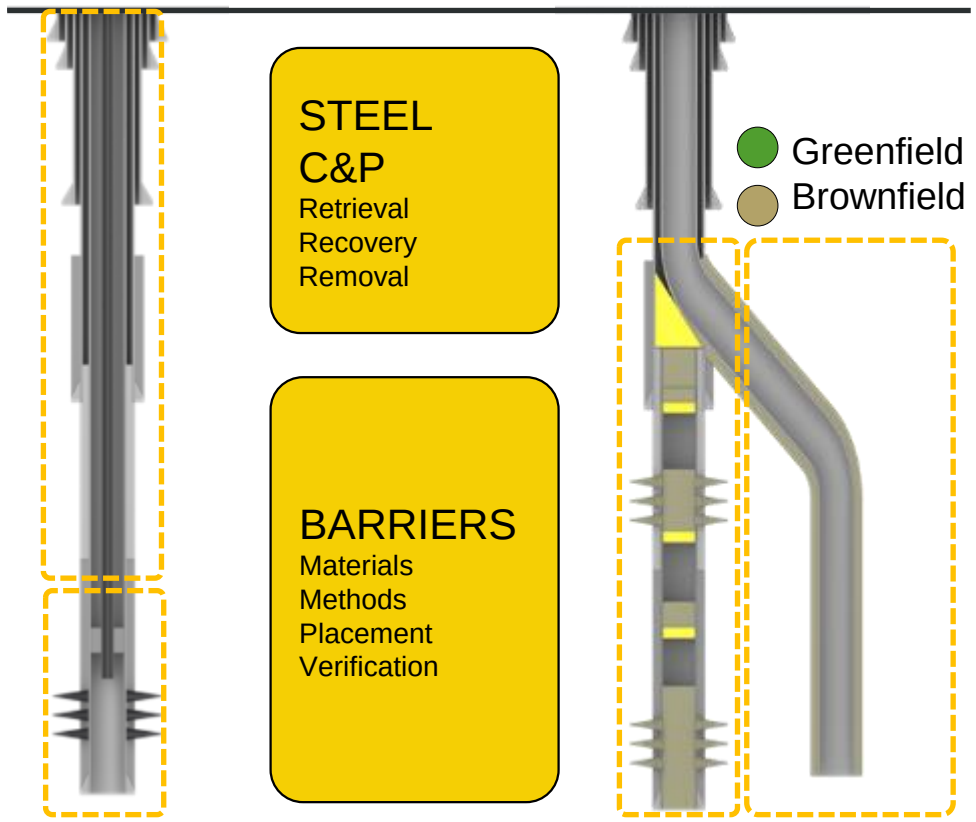
Agenda

1. Basic Intro to Well Barriers and Slot Recovery
2. Decision Workflow – cost/effective solution
3. Well Cross-Sectional Barriers
4. Casing Cut and Pull Solutions/Combos
5. Case Studies
6. Q&A

P&A Cross Sectional Barriers and Slot Recovery

Basic Introduction



- MEASUREMENTS
- PLANNING & DESIGN
- BARRIERS PLACEMENT
- STEEL MANAGEMENT (C&P)

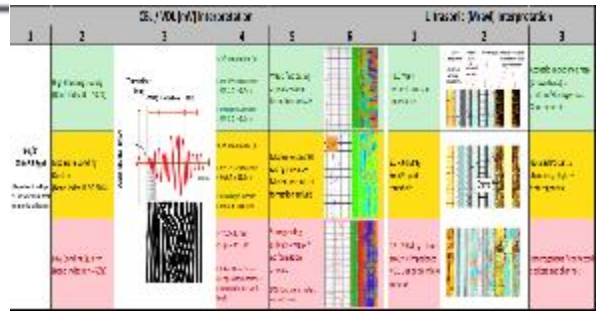
WELL P&A PLANNING & DESIGN

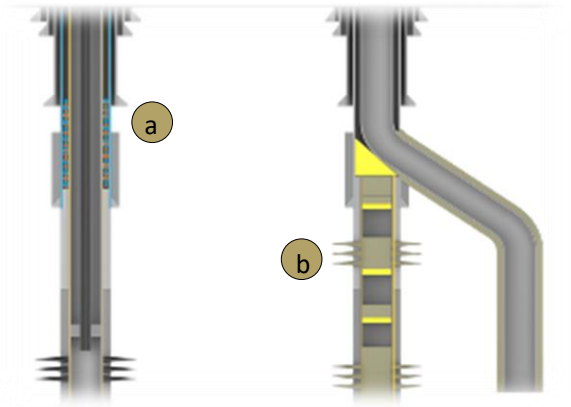
DECISION WORKFLOW BASED ON CEMENT LOGS

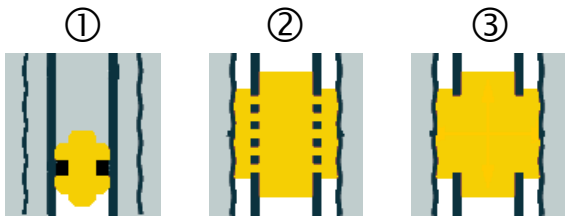
MEAUREMENTS

CASING C&P

BARRIERS







① **CBL higher than 20mV & Ultrasonic ½ - 2½ Mrayl**
Low Bonding – easy to Perf, Wash and Cement
(Expected CBL in free pipe 57mVfor 9-5/8 Casing)

② **CBL 10 to 20mV & Ultrasonic 2½ - 3 Mrayl**
Medium Bonding– Moderate to high chances to Perf, Wash and Cement in presence of channeling

③ **CBL 1 to 10mV & Ultrasonic higher than 3Mrayl**
High Bonding – difficult to Perf, Wash and Cement / Section Milling to be considered

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a Cut&Pull Casing (including dowhole Jack systems)

b Perf & CCR (Casingback side Cleaning and Recovery)

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① WELL BARRIERS – BALANCECEMENT PLUG
OPTIMAL WHEN CEMENTBOND IS HOMOGENOUS ANNULUS B AND C

② WELL BARRIERS – PERFORATE, WASH & CEMENT
OPTIMAL WHEN CEMENT BOND IS MEDIUM TO LOW

③ WELL BARRIERS – SECTION MILLING
OPTIMAL WHEN CEMENT BOND IS HIGH

Well Cross-Sectional Barriers

WELL BARRIERS – PERFORATE, WASH & CEMENT

The Perforate, Wash and Cement system provides an economical and effective alternative to traditional plug and abandonment (P&A).

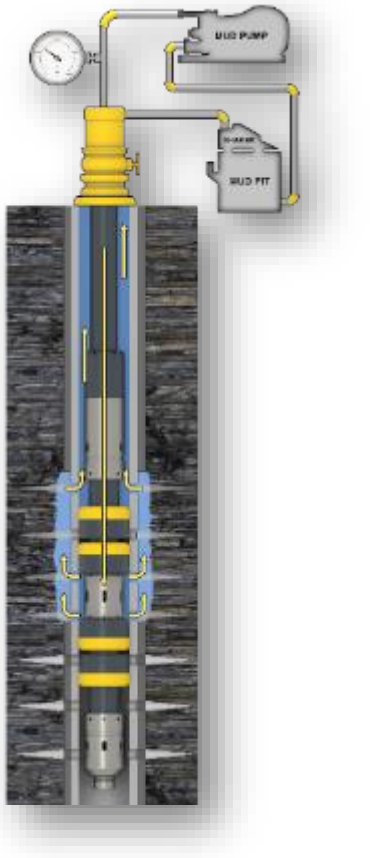
As an option for section milling, the systems deliver a step-change in efficiency for P&A. Together with Tubing Conveyed Perforating (TCP) products an efficient and safe execution of operations provides time and cost savings for well P&A operations.

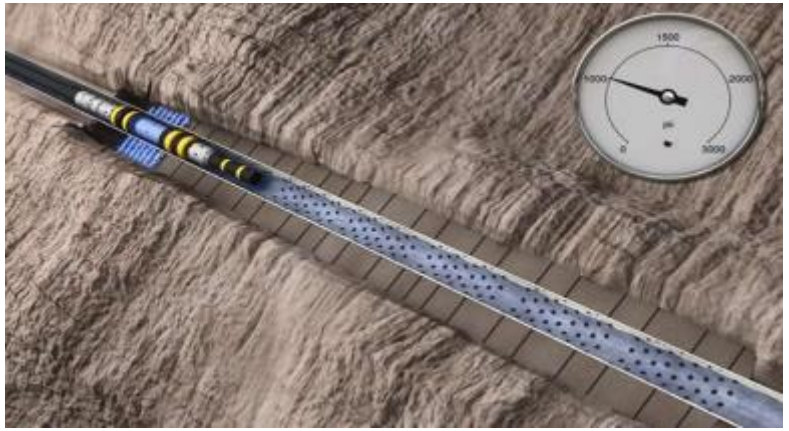
Features and Benefits

- Time-saving
- Closed loop system for optimum use of hydraulic energy
- Single trip, no rotation, combinable with C&P
- Combinable with TCP or Mechanical perforators

Typical length of interval

- Combining Primary and Secondary Barrier
  - 80 m to cover min 2 x 30 m
- Single Barrier
  - 50 m to cover min 1 x 30 m





Remediate: Cement in dual casing 7” x 9 5/8” CFD and Testing

CFD

- Good particle activation in both annuli
- Time based plots indicate that particles will evacuate from the inner annulus prior to the outer
- Account for increased time required to clean two annuli (Time x 2)

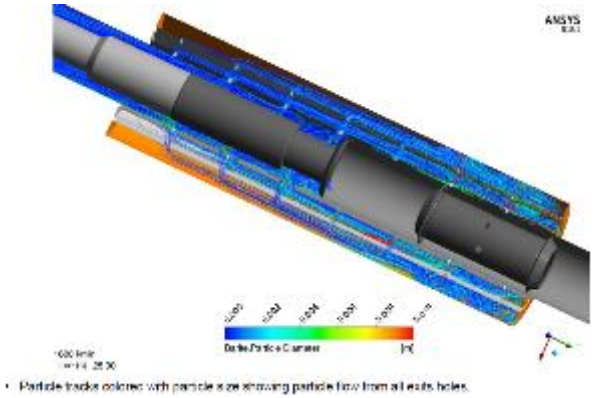
Testing

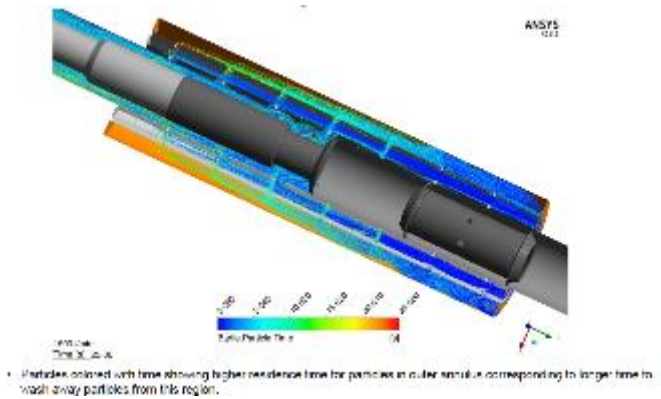
- Both annuli with dried and packed barite
- Inner annulus first clean prior to seeing effect in the outer
- ½ x Pump & Pull Speed for cementing

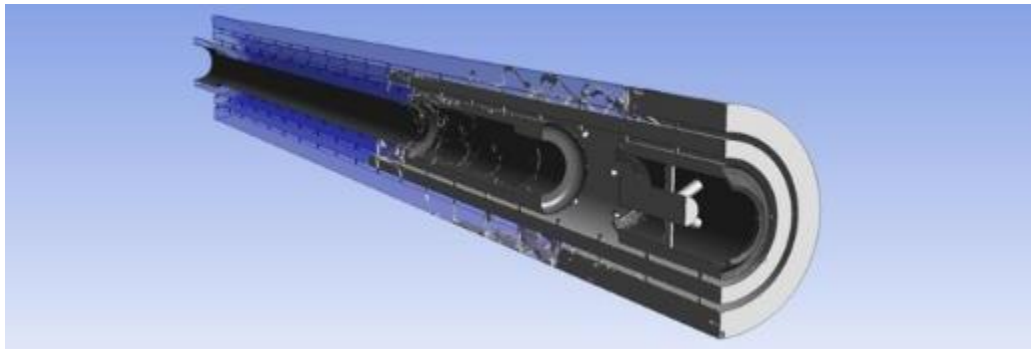
Pic 2 Annuluses filled with settled Barite

Pic 5 Clean out finished, perforations are now visible.

Pic 7 Cement job performed.





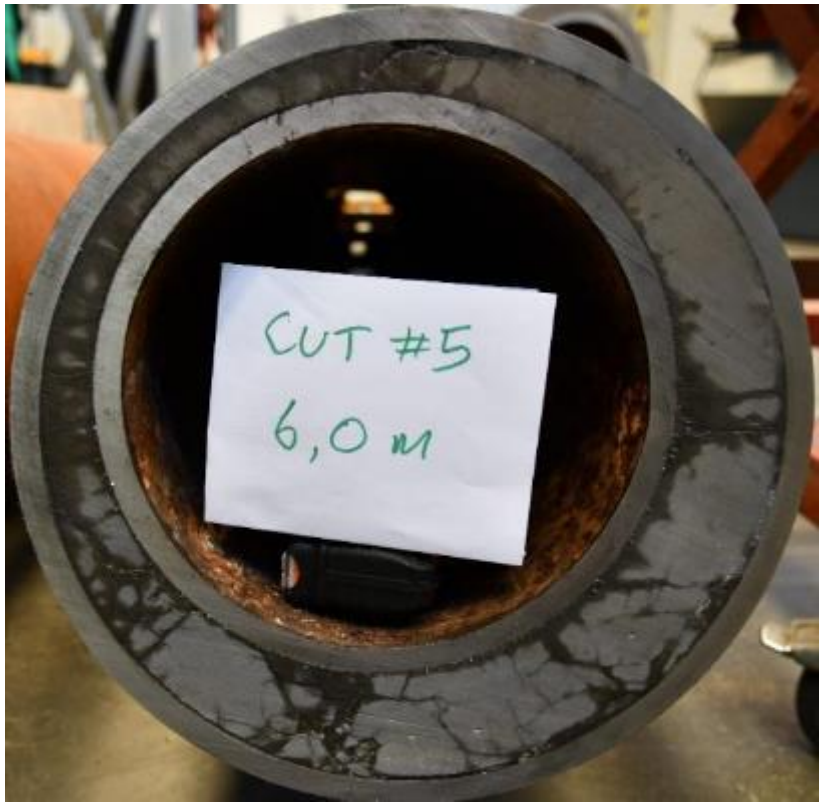


Remediate: Cement in dual casing 7” x 9 5/8” x 13-3/8” CFD and Testing

The objective was to perforate both casings without damaging the outer most casing, wash A and B annulus and place cement material in both. The testing was very successful and CFD proved the close loop system can wash and cement 2nd annulus.

Remediate: Cement in single casing 9 5/8” x 13-3/8” Testing

The objective of the test repairing cement in a single annuli, makes it possible to see how the cement has successfully injected in all cracks and formed a uniform cement seal. The pictures below are representing how the remediated section looks like with old cracked cement in gray and the new squeezed cement inked in dark black (both cements were set at the time of the picture)



Remediate: Cement in dual casing 7” x 9 5/8” CFD and Testing validated by Successful Job

Challenge

Pressure had been observed on the B annulus between 7” 29# and 9 ⅝” 40# casing of up to 1100 kPa. Gas was clearly migrating through a poor foam cement job.

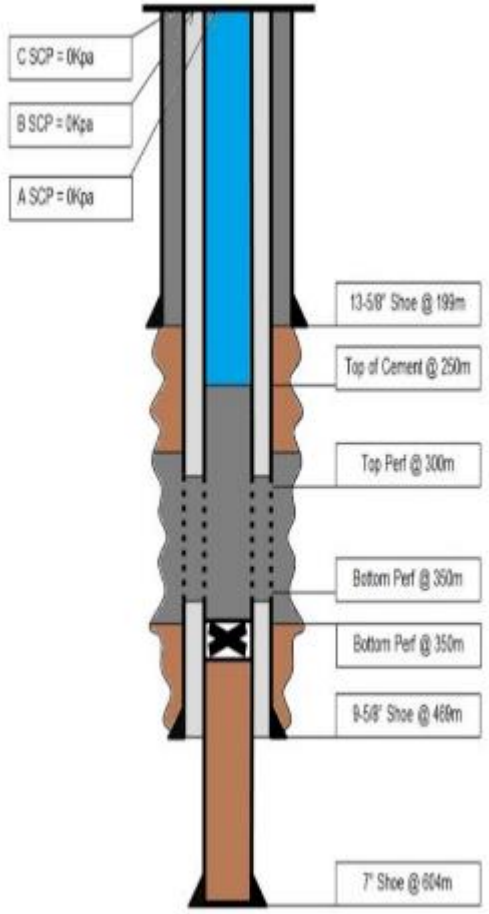
Solution

A thorough wash through 7”x 9 ⅝” into 12.5” bore hole with 10,4ppg weighted mud followed by a systematic spacer/ cementing pump and pull process weighted 12.5ppg Class E + and 15.8ppg Class G respectively. The close loop system with opposing swab cups allowed us confidently to displace the cement exactly into the target zone through the perforations.

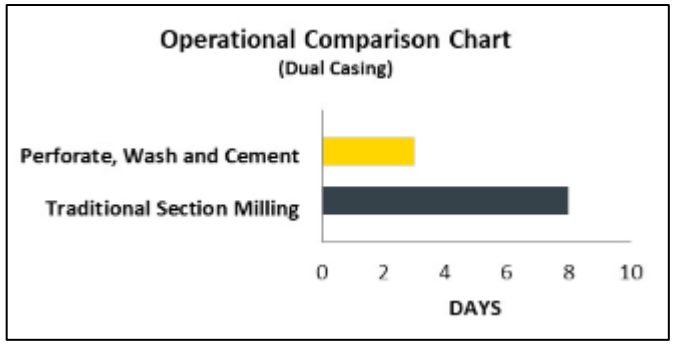
Result

A solid rock to rock barrier replacing the original poor foam cement. Gas migration to surface has now ceased, allowing surface casing pressure to read 0 kPa after final bleed off inside of the B annulus. The well now no longer requiring constant manual bleed down by well integrity operators to keep below the MAASP rating of 1500 kPa. Six months on from the operation being conducted and pressure at surface remains at 0 kPA

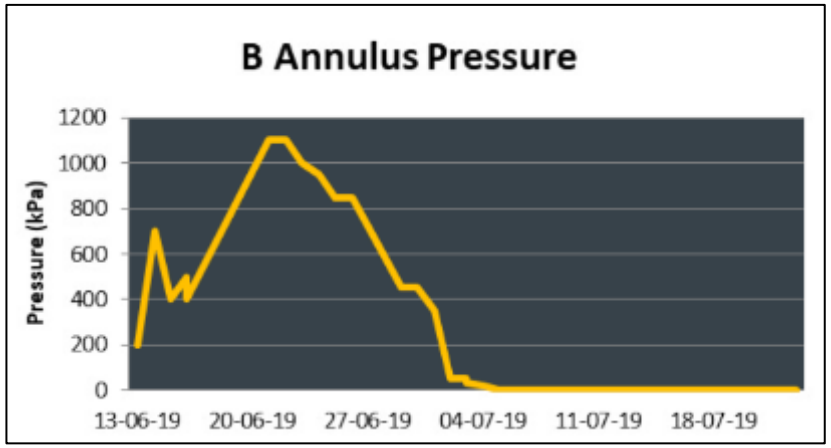
7” x 9-5/8” Dual Casing



Job Duration Dual Casing



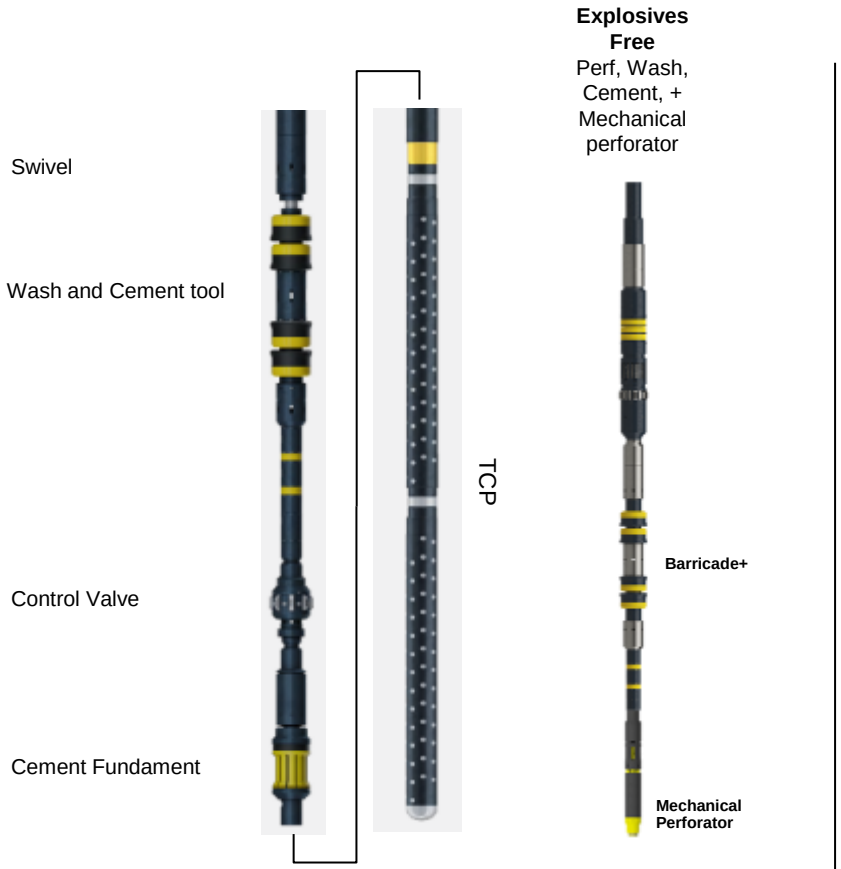
SAP is Cured



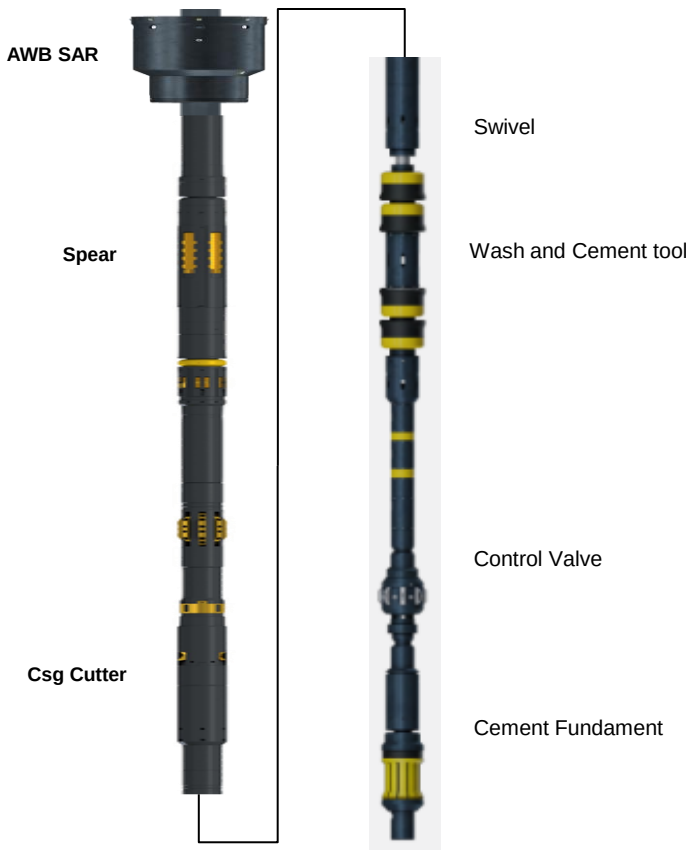
B Annulus Pressure reduced from 1100 kPa to 0 kPa

2. Casing Cut & Pull Solutions

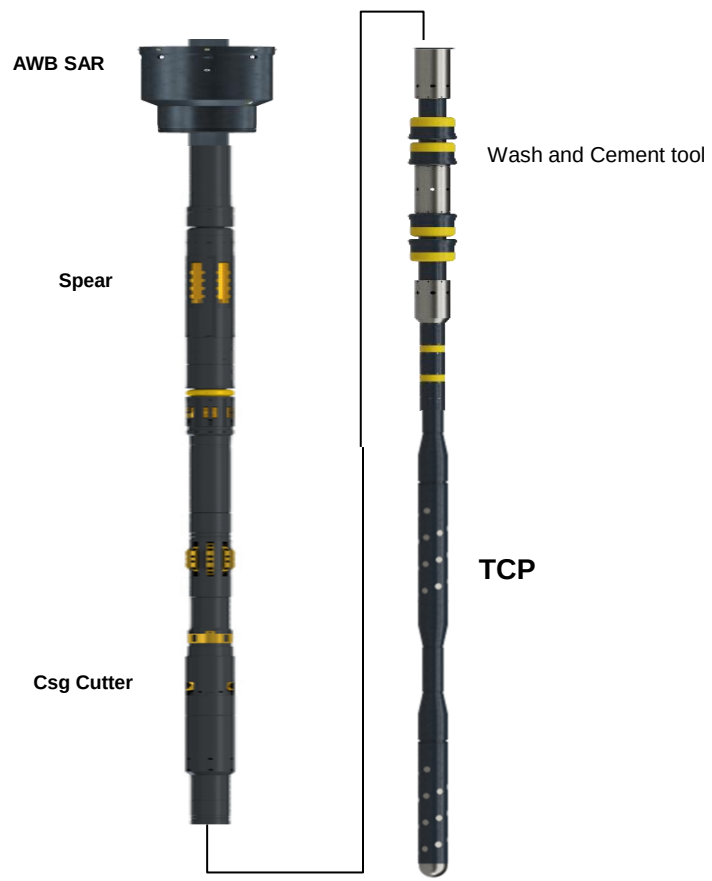
Single Trip Solutions



1 Single Trip Perf, Wash, Cement



2 Single Trip Perf, Wash, Cement + C&P

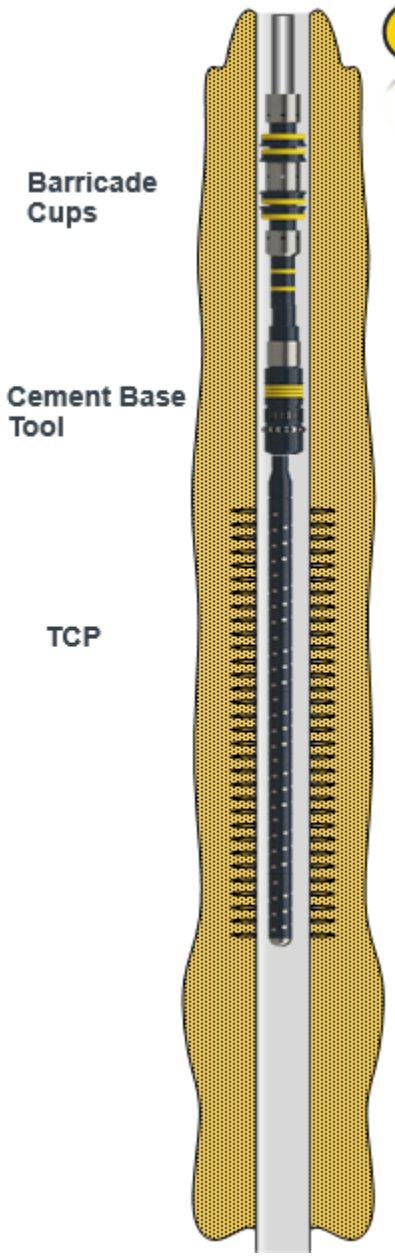


3 Single Trip Formation Testing + C&P

1 AWB SAR & Barricade - Perf Wash & Cement

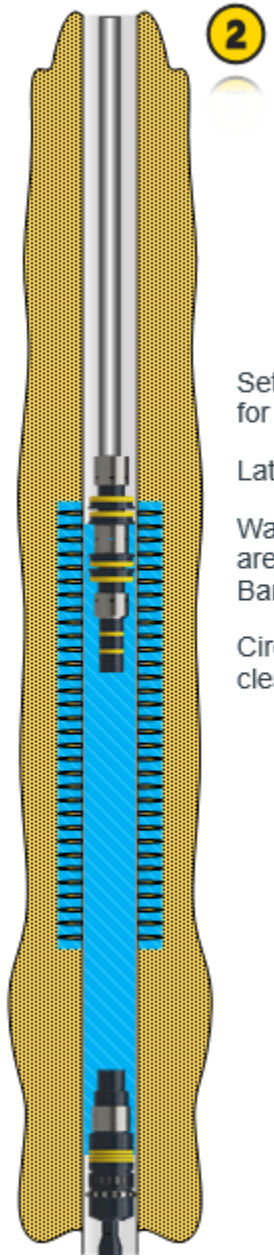
RIH and land the AWB SAR in the WH

Shear out RT and continue RIH with BHA



Continue RIH with TCP, plug & Barricade

Perform perforation across open hole

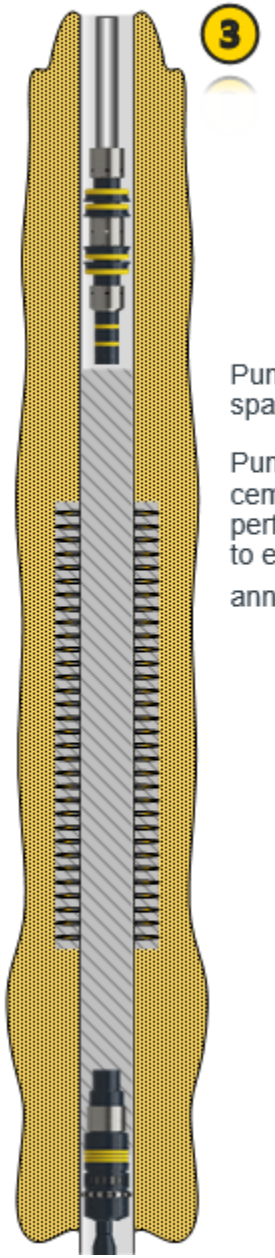


Set plug as base for cement

Latch off plug

Wash perforated area with Barricade cups

Circulate hole clean

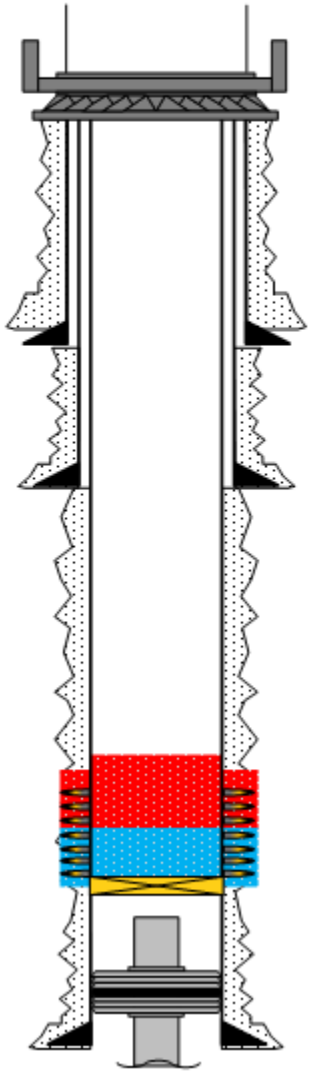


Pump & Pull spacer

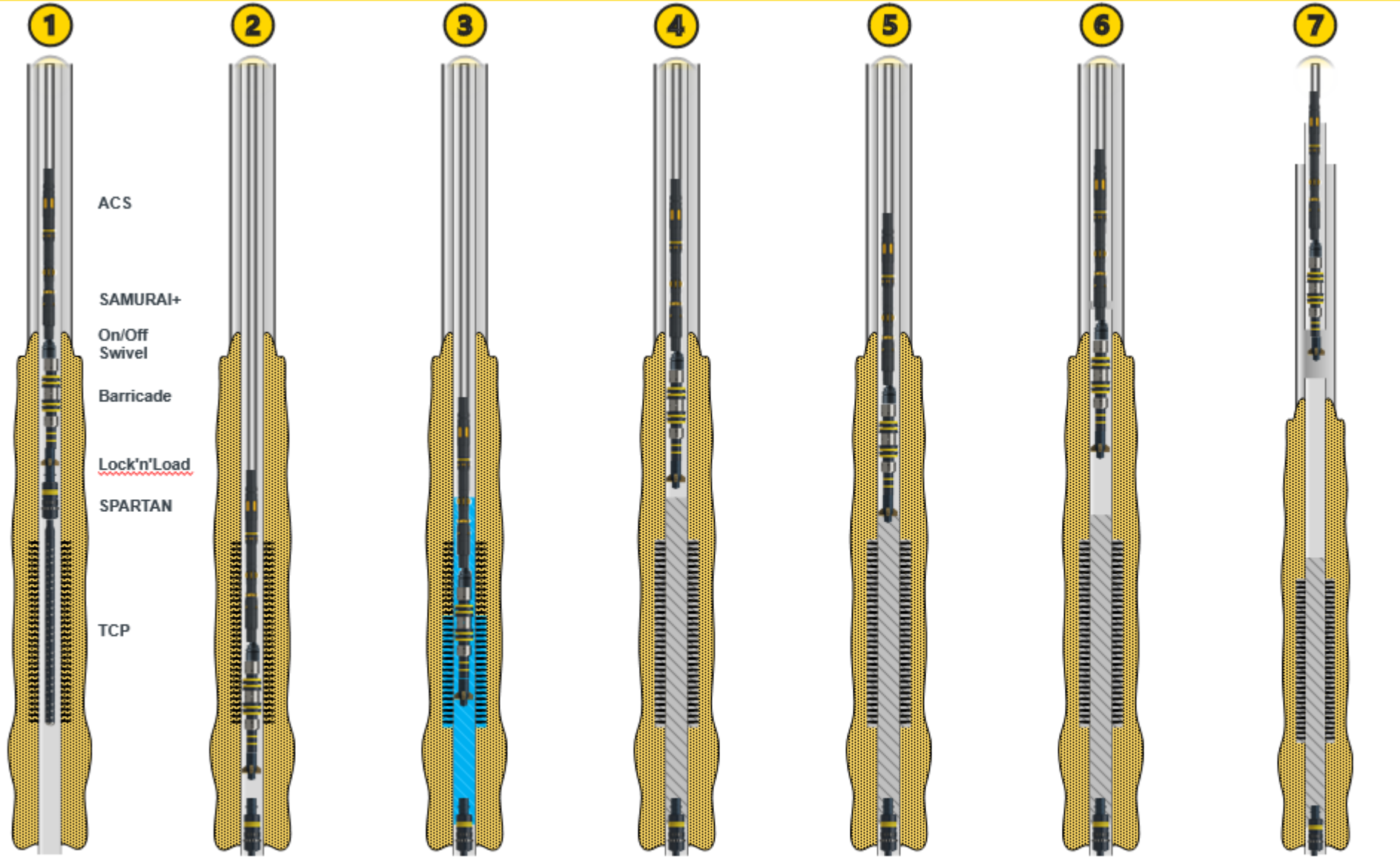
Pump & Pull cement across perforated area to establish

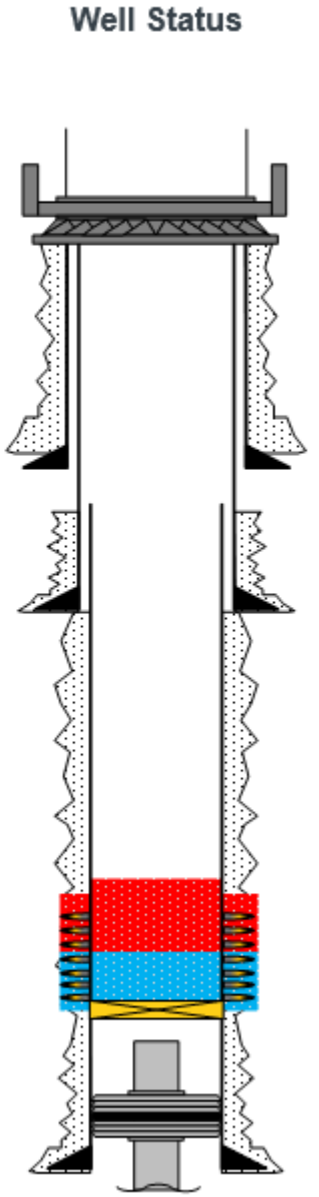
annulus barrier

Well Status

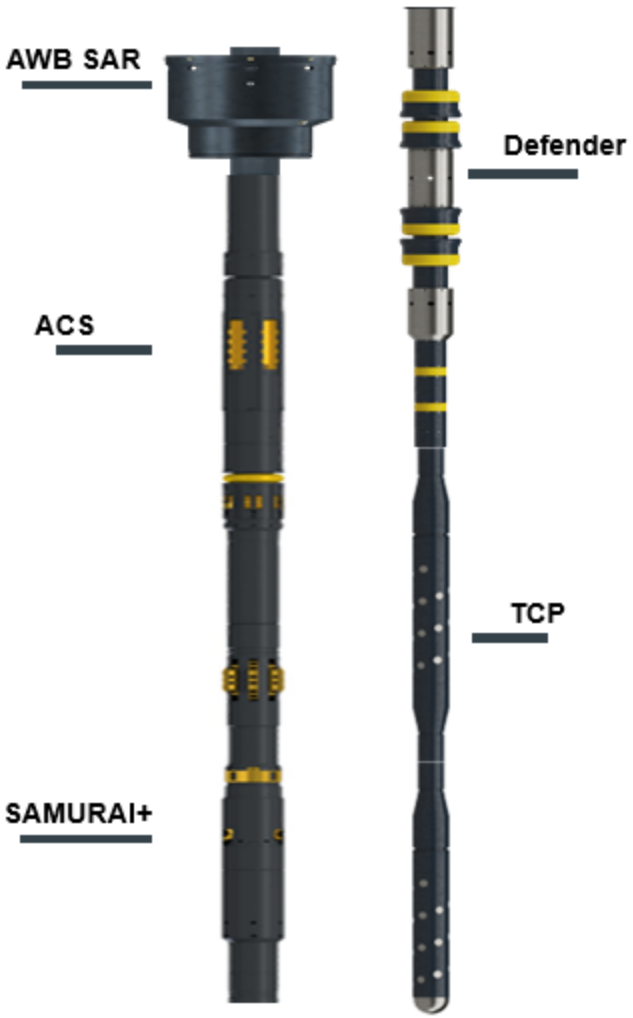


2 PWC Combined with Cut & Pull Casing





3 AWB SAR, TCP, Formation testing, Cement, Cut & Pull Casing



Set AWB SAR

Perforate Casing

Test formation

Release from Defender

Place cement plug

WOC

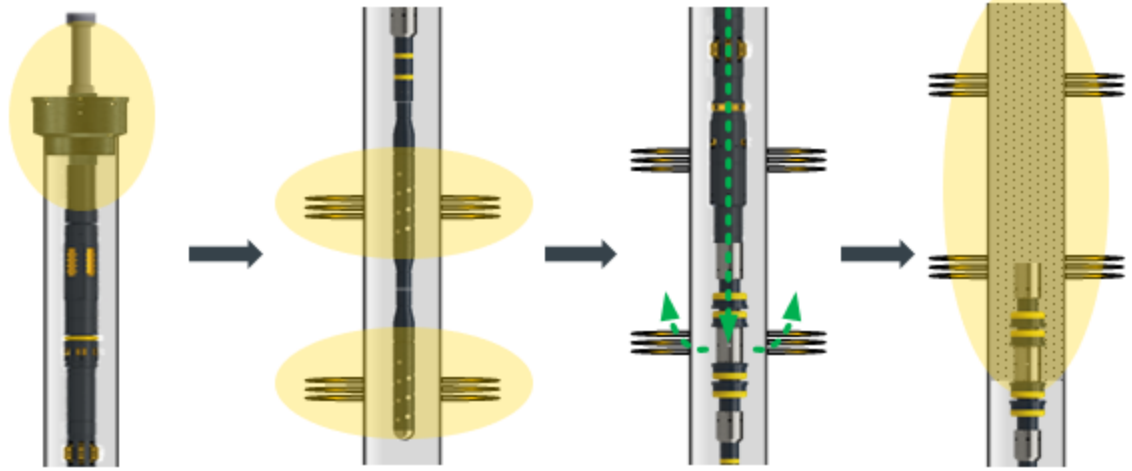
Tag cement

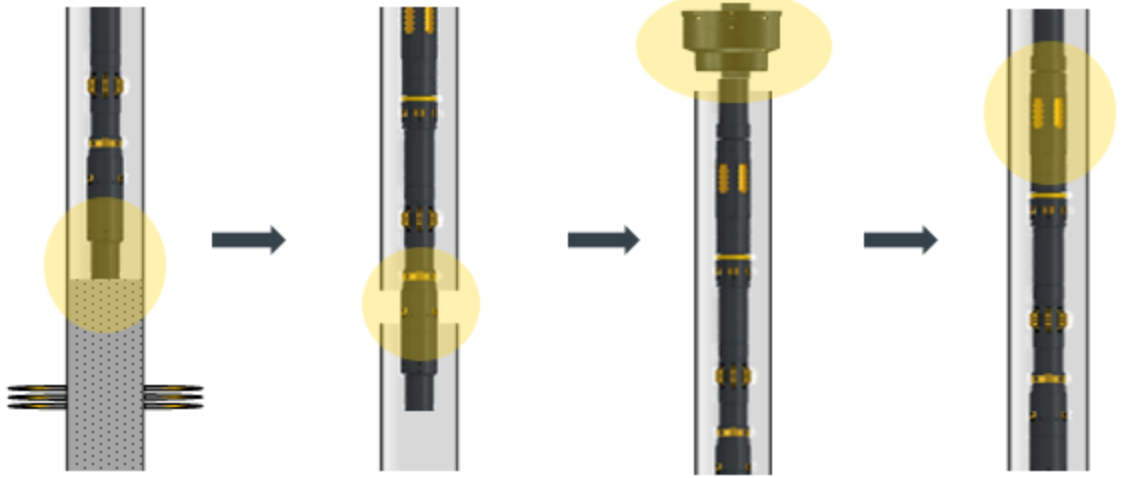
Cut Casing with SAMURAI

Pull AWB SAR

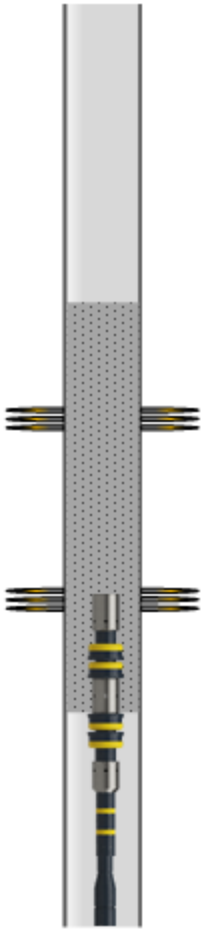
Engage ACS and pull Casing

Operational Sequence





Final Well Status



4. Case Studies

a) Repsol Gyda Platform (Norway)

- Scope **32 Wells to P&A** from 2019-2021
- **Optimized POB model with Multiskilled** Integrated in Drilling Crew
- **New technologies** Implemented within **Fishing, Milling, barrier verification & barrier installation** using Perforate Wash and Cement.
- **RNX Roughneck** that can break tubing & casing up to 13 3/8” **eliminated the need for casing tongs & Crew**
- The Future of Rig Services & Integrated Well Services for Workover, Slot Recovery & Permanent Plug & Abandonment of Wells.

Gyda Platform

The Gyda field was proven in 1980 and developed by the use of an integrated steel platform at a depth of 66 meters. The oil was transported by pipeline to Teesside via Ekofisk. The gas was piped to the Ekofisk complex and on to Emden.

In June 2017 the Norwegian authorities approved the decommission plan for the Gyda field. The decommission scope includes permanent plugging of 32 wells on the field, removal of platform and undercarriage, as well as removal of installations on the seabed. All Gyda installations should be removed by 2023.

Operator:

- Repsol Norge AS

Production start-up:

- 21 june 1990

Cease of Production:

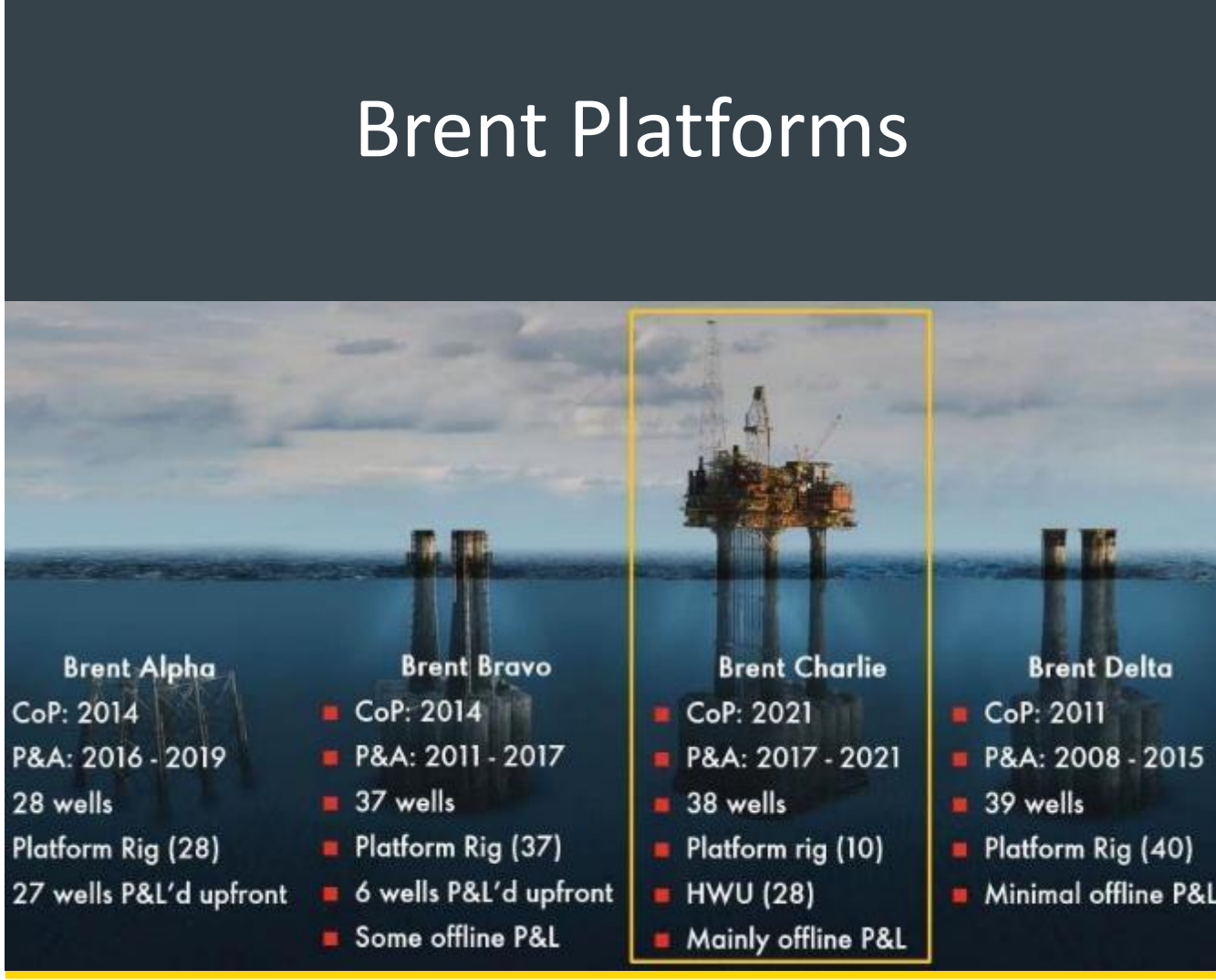
- 29 february 2020

Licensees:

- Repsol Norge AS 61%

b) Shell Brent Project (UK)

- Scope 38 Wells to P&A from 2017-2021
- Efficiency Enabler **The Perforate, Wash and Cement System** tailored for Hydraulic Workover Units
- Implemented **the single trip Cut & Pull Systems**
- **10 Perf, Wash and cement jobs** on Brent Project
- **100%** Reliability
- **Optimized** for low flow and no rotation
- **60 hrs.** and **100-ton CO2 saving** per barrier
- Up to **70% rig cost reduction**



b) Equinor Statfjord A (Norway)

+ Optimize Well abandonment in 3 steps

1
Preparation Rig less

1. Kill well
2. Install deep barriers
3. Perforate
4. Clean well
5. Install BOP
6. Pull Tubing
7. Verify barrier
8. Establish temp barrier

2
P&A with rig

1. Install primary barriers (either cmt plug, formation test or PWC (if not performed rigless)
2. Cut and Pull Casing
3. Install Surface Plug (Environmental)

3
Final PP&A

- Cut and remove Conductor Remove Wellhead
- Dismantle structures

Statfjord Platform

THANK YOU

Q&A

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