A Cost Efficient Approach to Rigless P&A for Future Projects

Amalie Frafjord Andersen & Sara Marlen Kolstø

Agenda

01	Who we are
02	Scope of thesis & rigless P&A
03	Cases
04	Cost analysis
05	Result & Conclusion

Who Are We?

- Amalie Frafjord Andersen & Sara Marlen Kolstø
- Graduated from UiS in 2025 with a Master degree in Industrial Economy
- Graduates in Aker BP

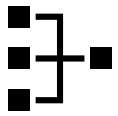
Scope of Thesis

To what extent can rigless technologies offer a safer, cost-efficient, and lower-emission approach to P&A of platform wells in compliance with regulatory requirements?

- Cases:
  - Base Case: Conventional Drilling Rig (XLE jack-up rig)
  - Case 1: Modular Drilling Rigs (MDR)
  - Case 2: New rigless technologies
- Methodology:
  - Monte Carlo simulations for cost and time (Base Case & Cases 1 & 2)

PS: This Master Thesis is submitted to the University in Stavanger under supervision from Aker BP.

What is Rigless P&A?



Modular Drilling Rig

Flexible interventions

Cost-effective

Environmental Perspective

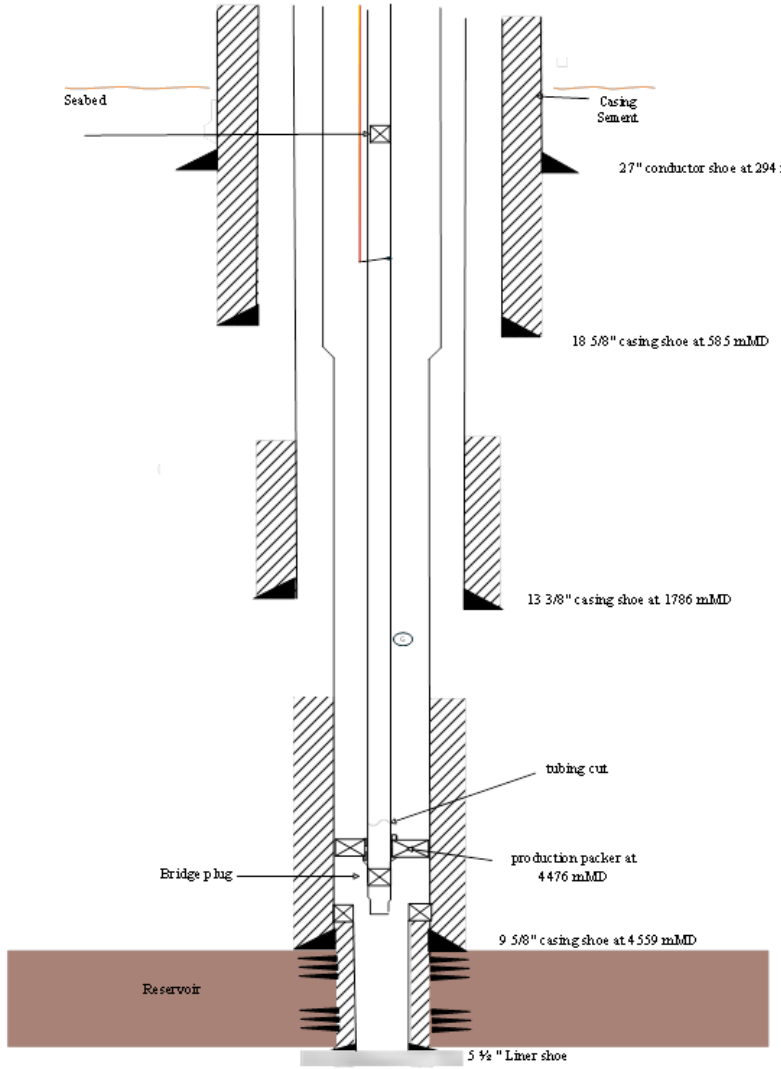
- In this study, rigless P&A is defined as a set of technologies that enable well abandonment without the use of conventional drilling rigs

Cases

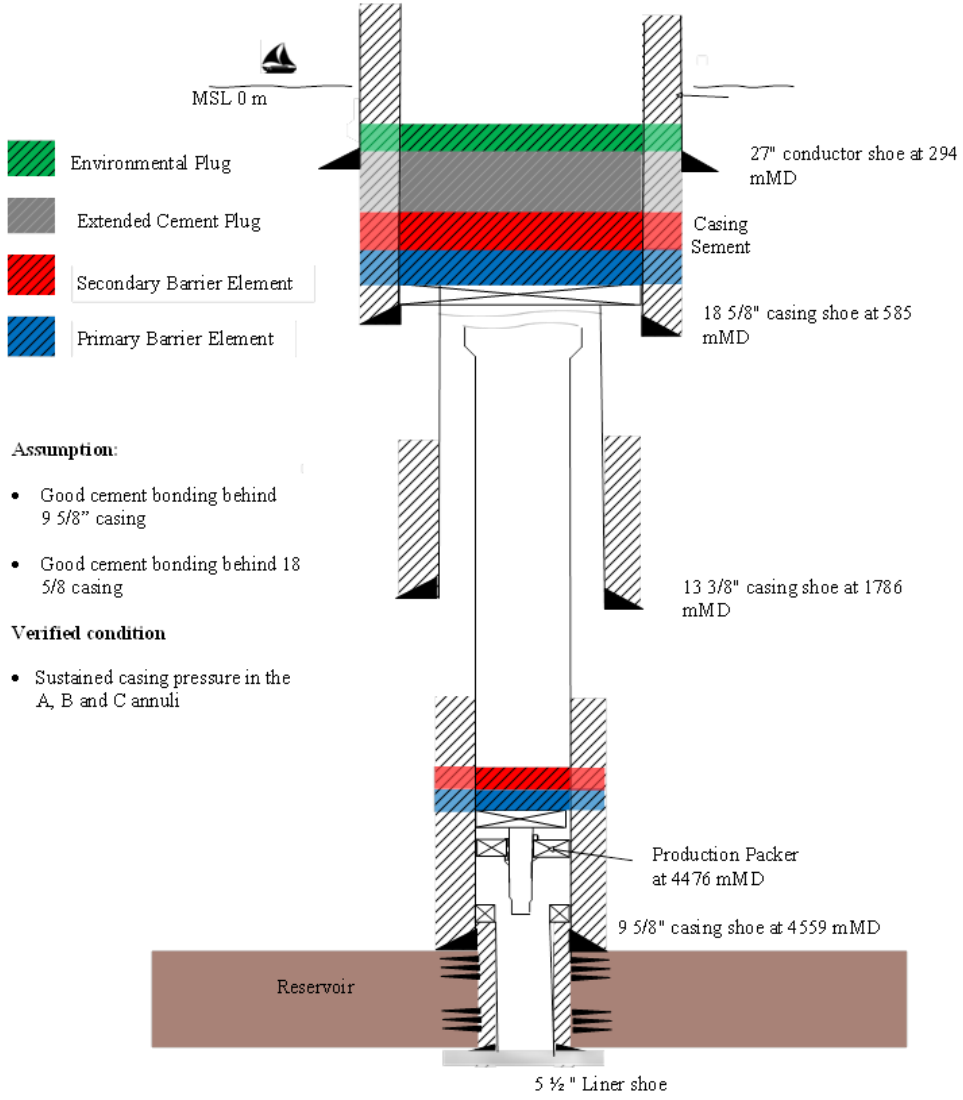
- P&A Phase 2

CASE	APPROACH	TECHNOLOGY USED	OPERATIONAL STEPS
Base Case	Rig-based	XLE rig	Full rig-based P&A with drill pipe operations
Case 1: MDR	Rigless	Modular Drilling Rig	Full abandonment with MDR including cutting, plugging, and barrier verification
Case 2: New Technology	Rigless	Wireline, Dual Logging, Axter System, dSolve, Bismuth, MDR	Dual logging, barrier installation through tubing using a wireline, then MDR

The Well Design Used for All the Cases



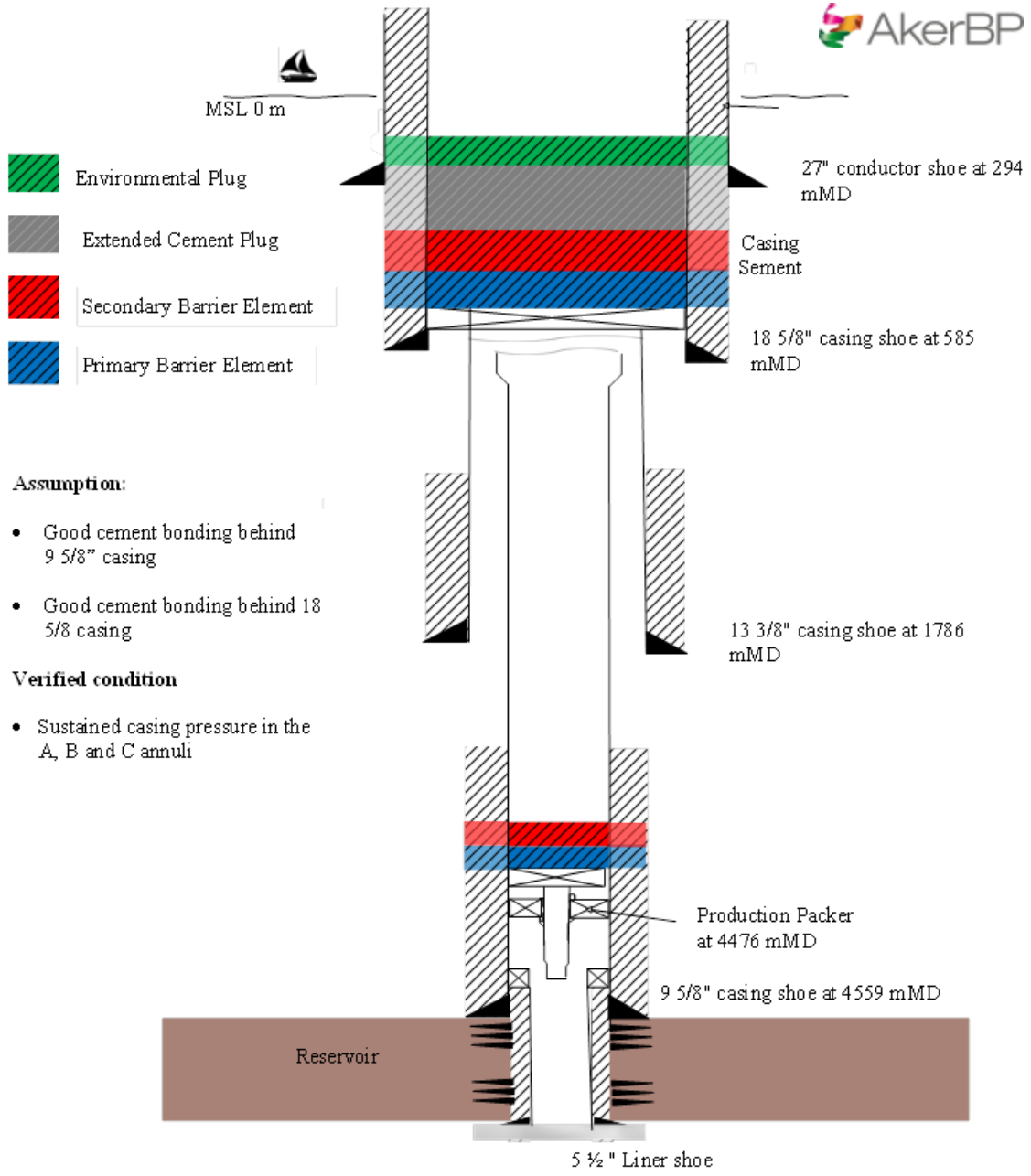
P&A phase 1: Before permanent P&A



P&A phase 2: Permanent P&A

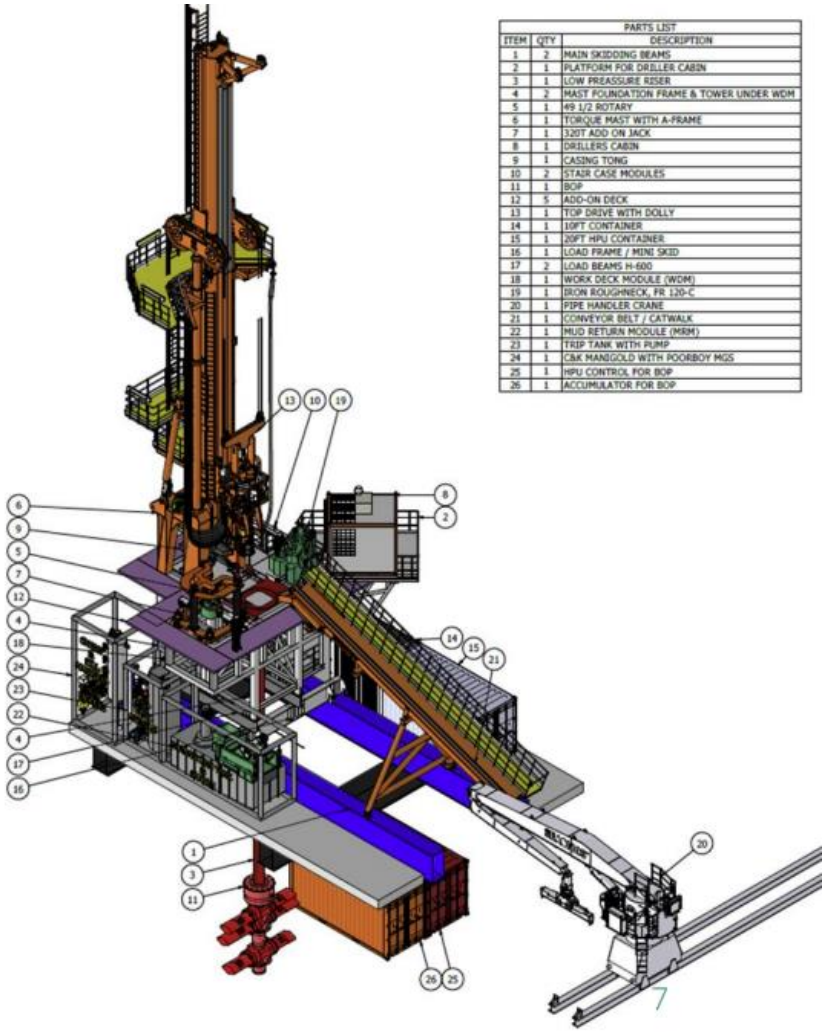
Base Case: Procedure

- Cut and retrieve the production tubing
- Clean and log behind the 9 5/8” casing
- Set bridge plug & cement in 9 5/8” casing
- Cut & pull 10 3/4”
- Cut & pull 13 3/8” casing
- Set mechanical plug & cement in 18 5/8” casing
- Log behind the 18 5/8” casing
- Set environmental plug



Case 1: Modular drilling Rig (MDR)

- What is an MDR?
- Four fundamental functions:
  1. Tubing pulling operations
  2. Structural support for vertical operations
  3. Automated tubular handling and hoisting
  4. Circulation and pressure control systems

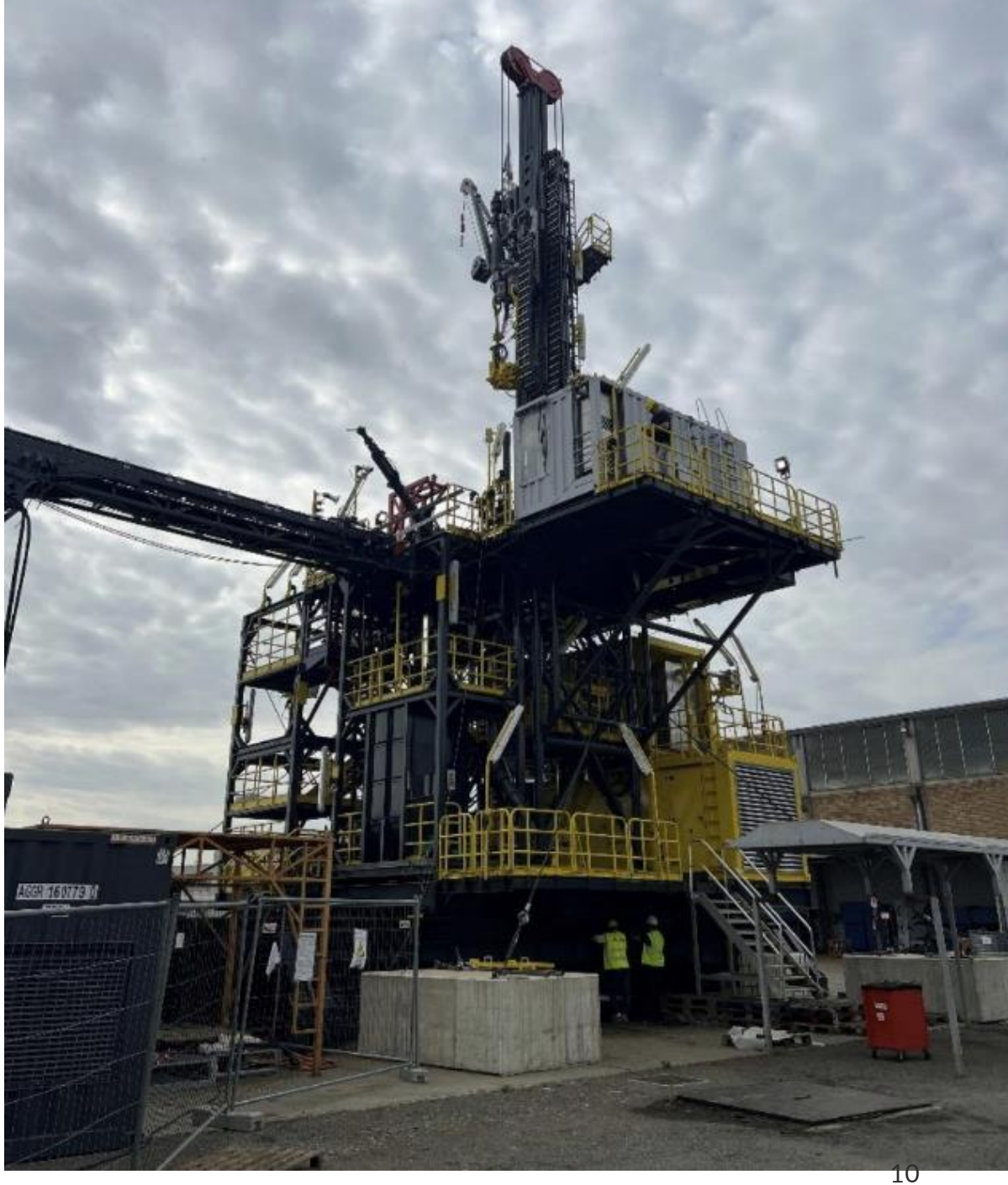


PARTS LIST		
ITEM	QTY	DESCRIPTION
1	2	MAIN SKIDDING BEAMS
2	1	PLATFORM FOR DRILLER CABIN
3	1	LOW PREASSURE RISER
4	2	MAST FOUNDATION FRAME & TOWER UNDER WDM
5	1	49 1/2 ROTARY
6	1	TORQUE MAST WITH A-FRAME
7	1	320T ADD ON JACK
8	1	DRILLERS CABIN
9	1	CASING TONG
10	2	STAIR CASE MODULES
11	1	BOP
12	5	ADD-ON DECK
13	1	TOP DRIVE WITH DOLLY
14	1	10FT CONTAINER
15	1	20FT HPU CONTAINER
16	1	LOAD FRAME / MINI SKID
17	2	LOAD BEAMS H-600
18	1	WORK DECK MODULE (WDM)
19	1	IRON ROUGHNECK, FR 120-C
20	1	PIPE HANDLER CRANE
21	1	CONVEYOR BELT / CATWALK
22	1	MUD RETURN MODULE (MRM)
23	1	TRIP TANK WITH PUMP
24	1	C&K MANIFOLD WITH POORBOY MGS
25	1	HPU CONTROL FOR BOP
26	1	ACCUMULATOR FOR BOP

Illustrating an MDR from Odfjell Technology

Case 1: Procedure

- Perform the same steps as Base Case
- Challenge: Slower
- Advantage: Lower daily operational cost
- More economical?

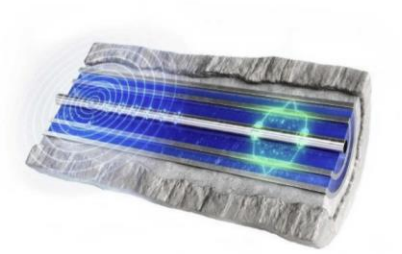


Archer MDR

Case 2: New Rigless Technologies

- **Case 2A:**

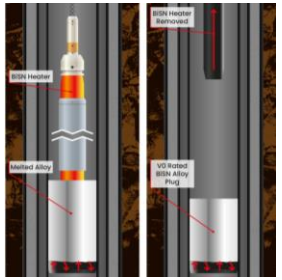
Epilogue: Dual Logging



Axter Retrieve

dSolve

wel-lok™ Tubing Seal

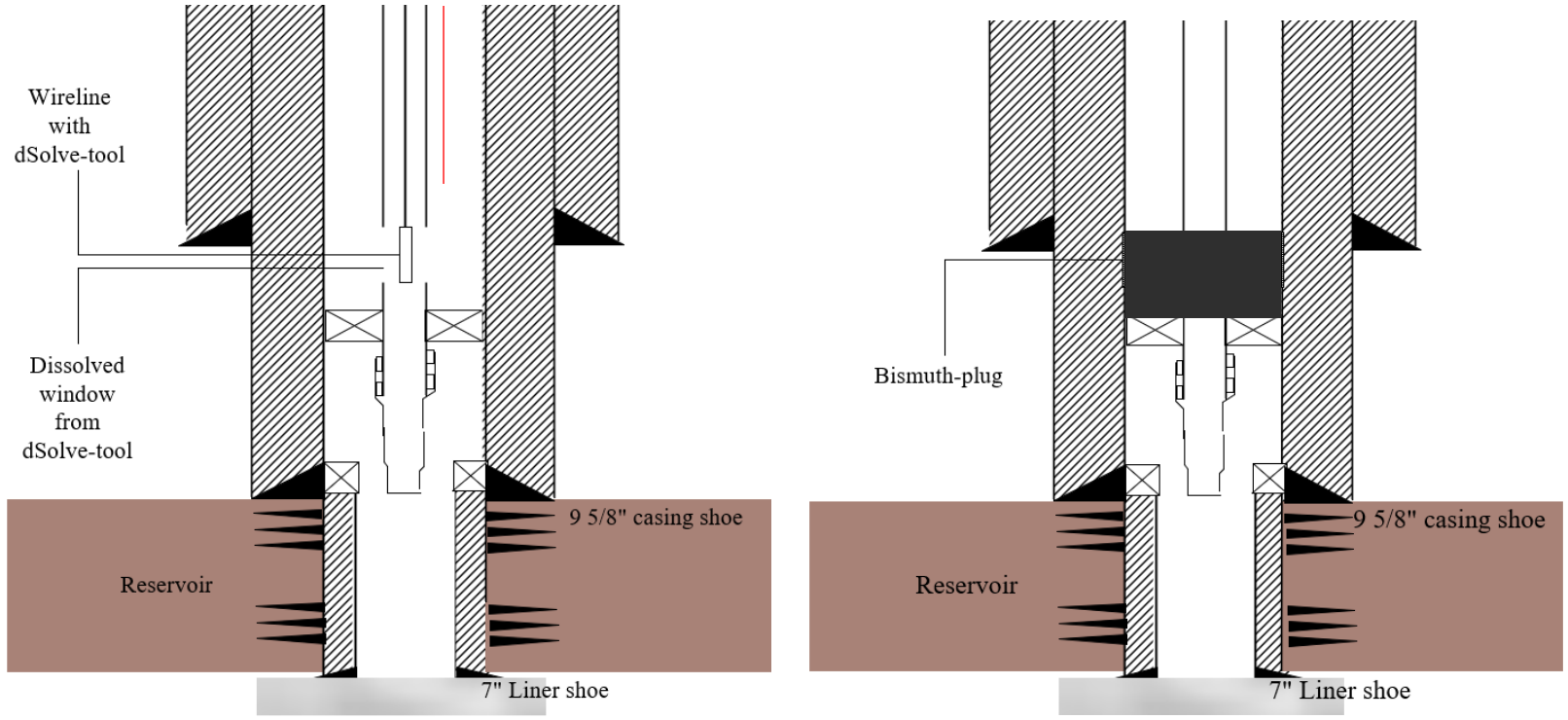


- **Case 2B:**

RockSolid

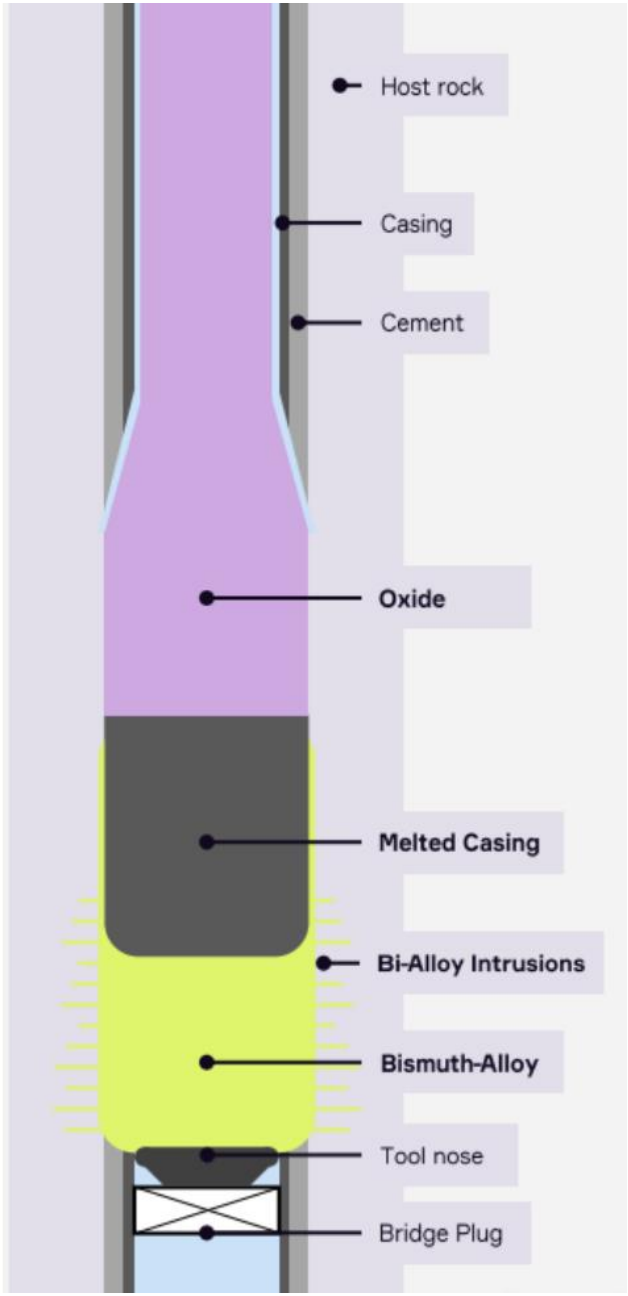
Case 2A: Procedure

- Reservoir Barrier:
  - Dual Logging
  - Remove control lines with Axter System
  - DSolve tool dissolve specific sections of tubing
  - Bismuth Plug
- Upper Barrier & Environmental plug:
  - MDR



Case 2B: Procedure

- Reservoir Barrier
  - RockSolid
    - Thermite-based exothermic reaction
    - Expand from within the tubing through the 9 5/8” casing
- Upper Barrier & Environmental plug:
  - MDR



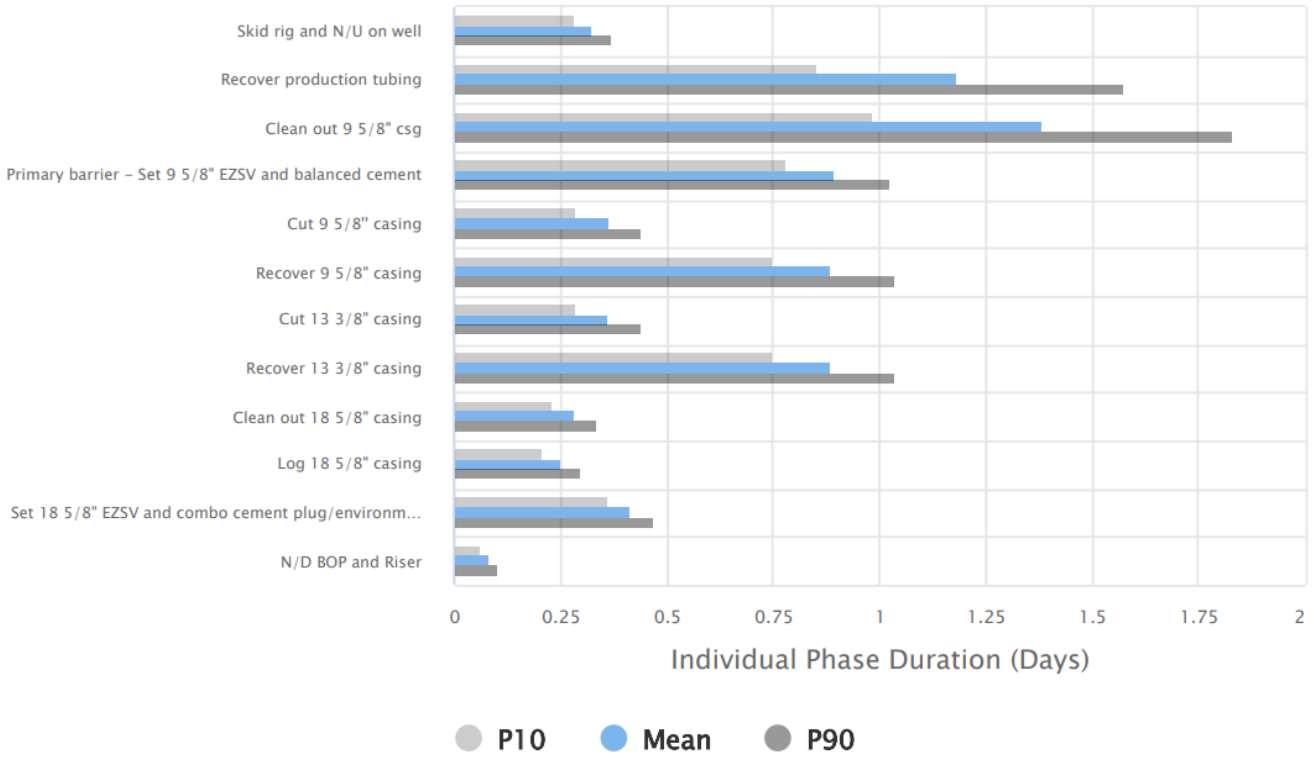
Cost Analysis – Input

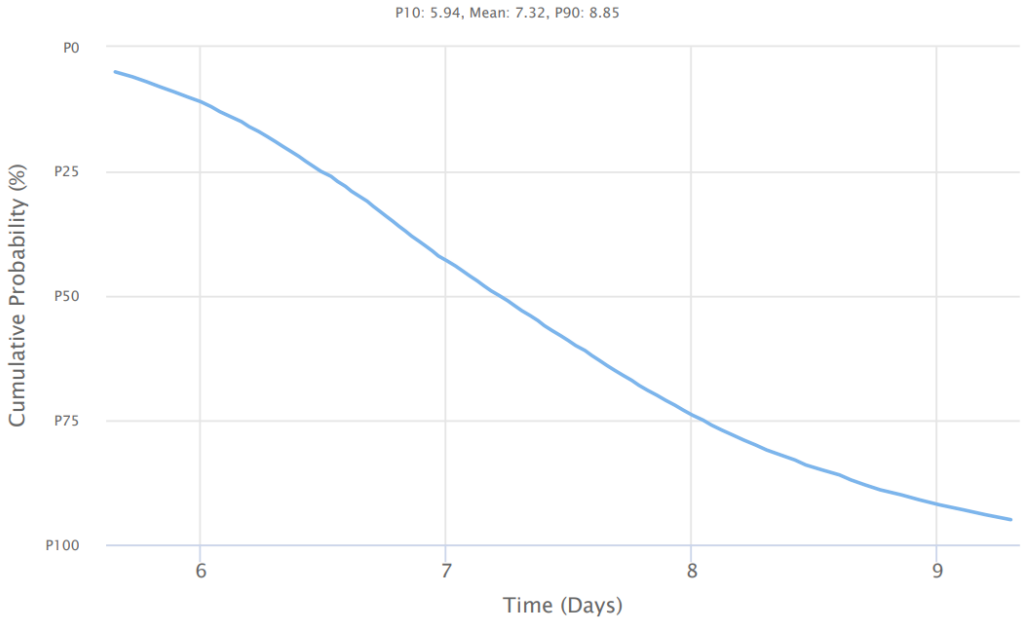
- Methodology
  - Monte Carlo simulation
- Data Collection
  - Time
    - Tripping, racking, POOH
  - Costs
    - Daily operational cost of XLE rig, MDR and wireline
    - Confidential, uses % as cost relative to base case
- Input data provided by Aker BP and vendors

Phase/Event Name	Distribution Type	Variable Unit
Skid rig and N/U on well		
Skid rig	Pert	Hours
Secure rig and prepare slot	Pert	Hours
Land HP and BOP riser on well	Pert	Hours
Land Bell nipple and diverter	Pert	Hours
Fill riser	Pert	Hours
Perform a connector test	Pert	Hours
Recover production tubing		
Pre job meeting	Spike	Hours
M/U Spear BHA	Pert	Hours
Engage Spear	Pert	Hours
Cycle open shallow e-Red valves	Pert	Hours
Pull TH free	Uniform	Hours
Circulate and condition mud	Pert	Hours
Flow check	Spike	Hours
POOH	Pert	Trips(Mt/Hr)
L/D Spear BHA	Pert	Hours
R/U casing equipment	Pert	Hours
Continue to pull and R/B tubing	Pert	Trips(Mt/Hr)
R/D casing handling equipment	Pert	Hours
Clean and clear rig floor	Spike	Hours
Clean out 9 5/8" csg		
Pre job meeting	Spike	Hours
M/U Cleanout BHA	Pert	Hours
RIH to tubing stump	Pert	Trips(Mt/Hr)
Clean well	Pert	Hours
Flow check	Spike	Hours
POOH w/BHA and log	Pert	Trips(Mt/Hr)
L/D Cleanout BHA	Spike	Hours
Clean and clear rig floor	Spike	Hours
Primary barrier - Set 9 5/8" EZSV and balanced cement		
Pre job meeting	Spike	Hours
MU EZSV	Pert	Hours
RIH with EZSV	Pert	Trips(Mt/Hr)
Set, tag and test EZSV	Pert	Hours
Set balanced cement plug	Pert	Hours
Pull to TOC and circulate	Pert	Hours
POOH	Pert	Trips(Mt/Hr)
LD EZSV RT	Pert	Hours
Clean and clear rig floor	Spike	Hours
Cut 9 5/8" casing		
Pre job meeting	Spike	Hours
M/U cut BHA	Pert	Hours
RIH	Pert	Trips(Mt/Hr)
Circulate to condition mud	Pert	Hours
Cut 9 5/8" casing below 18 5/8" casing shoe	Pert	Hours
Circulate behind 9 5/8" casing	Pert	Hours
POOH with cut assemblies	Pert	Trips(Mt/Hr)
LD cut assemblies	Pert	Hours
Recover 9 5/8" casing		

Output From The Simulation

Base case

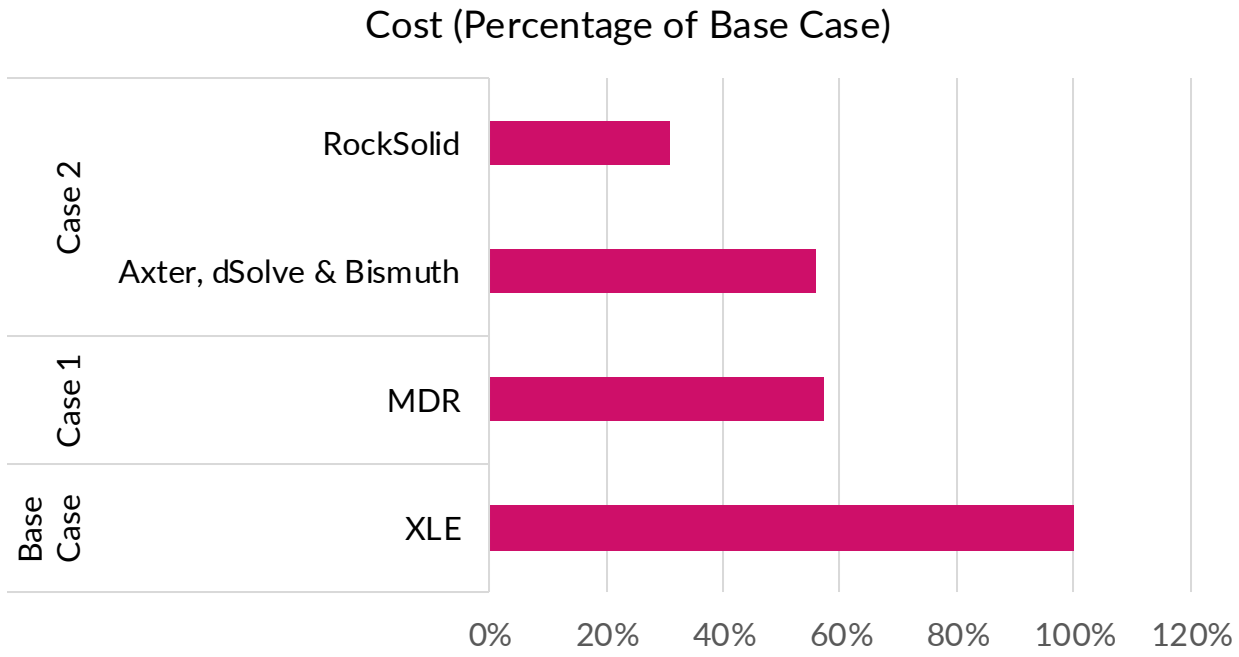




Results: Overview

DISCLAIMER: This is a static review of single well assuming technology readiness and is not including platform specific costs, tool run charges for new technology and other limitations (see next slide)

Case	Mean P&A Phase 2 Duration (days)	Mean Cost (% compared to Base Case)
Base Case: XLE	7,32	100 %
Case 1: MDR	10,93 (↑3,61)	57% (↓43%)
Case 2A: Axter, dSolve, Bismuth	12,45 (↑5,13)	56%(↓44%)
Case 2B: RockSolid	6,07 (↓1,25)	31% (↓69%)



Break- even cost: $$RigCost_{MDR} = \frac{RigCost_{XLE} \cdot OperationTime_{XLE}}{OperationTime_{MDR}} = \frac{1 \cdot 7.32\ days}{10.93\ days} = 0.67$$

Limitations & Indirect Costs

Charges for new technology
- Tool run charges
- Investments

Platform specific costs
- Conditions of platform
- Number of wells
- Platform utilities
- Deck space
- Crane conditions

Operational Risks
- High Risk Scenarios
- Multiple SOIs
- Well conditions deviating from ideal case in this presentation

Logistical challenges
- Crew Capacity
- WOW/NPT

Conclusion

Simulations indicate that rigless technologies perform P&A operations at lower cost compared to conventional drilling rigs

Compared to Base Case:

Case 1 had 43 % lower cost

Case 2A had 44 % lower cost

Case 2B had 69 % lower cost

DISCLAIMER: This is a static review of single well assuming technology readiness and is not including platform specific costs, tool run charges for new technology and other limitations.

The cost estimates does not include the expenses associated with new technologies → represent the maximum investment one could make while remaining more cost-effective than a conventional rig-based approach

www.akerbp.com