



TotalEnergies

The Next Generation of PWC, a Route to Further Reducing Overall P&A Costs and CO2 Emissions

SPE Well Abandonment Symposium - Aberdeen

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Context & Objectives

- **Context:**

- TotalEnergies has ~8000 wells to 'Plug & Abandon' (P&A), and over 15 G\$ of decommissioning liability on the balance sheet.
- ~50% spent on well P&A
- >200 wells in North Sea region
- >1200 wells in the Rest of the World
- Subject to increasing regulatory & public scrutiny and has to be permanent

- **Objectives:**

- Reduce the cost of well abandonment
- Maximise % of wells abandoned riglessly
- 22 TRM initiatives in 3 thematic groups

Well Abandonment Scope next 10 years:

Country	Field	Well Type	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Denmark	Regnar	Subsea	1									
	Mid Rosa 2	MLS	1									
	Dagmar	Platform		3								
	Svend	Platform			4							
	Gorm (97 wells)	Platform				5				11	11	11
	Dan							4				
Norway	Rolf	Platform					4					
	Atla	Subsea			1							
	Byggeve	Subsea			1							
NL	Skirne	Subsea			1							
	Explo	MLS				3						
	L7	Platform			5							
	K4-Z, K5-F, K4-D, L4-G	Subsea			6				1			
UK	various	Platform				1			14	14	5	5
	Janice	Subsea		4								
	Nuggets	Subsea					6					
	Alwyn	Platform								7	7	7
	Dunbar	Platform								7	7	7
UK	Quad 9 oil	subsea								10	10	10
	WoS area	subsea							5	5	5	
North Sea Region Totals			2	12	13	9	8	6	20	54	45	40
North Sea Region Cumulative			2	14	27	36	44	50	70	124	169	209

Country	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Myanmar						22				
Nigeria								130	130	122
Angola							40	39		
Austral	2	4	23	24			90	434		
Congo								57	153	8
Brazil	1	1								10
RoW Totals	3	5	23	24		22	130	660	283	140
RoW Cumulative	3	8	31	55	55	77	207	867	1150	1290

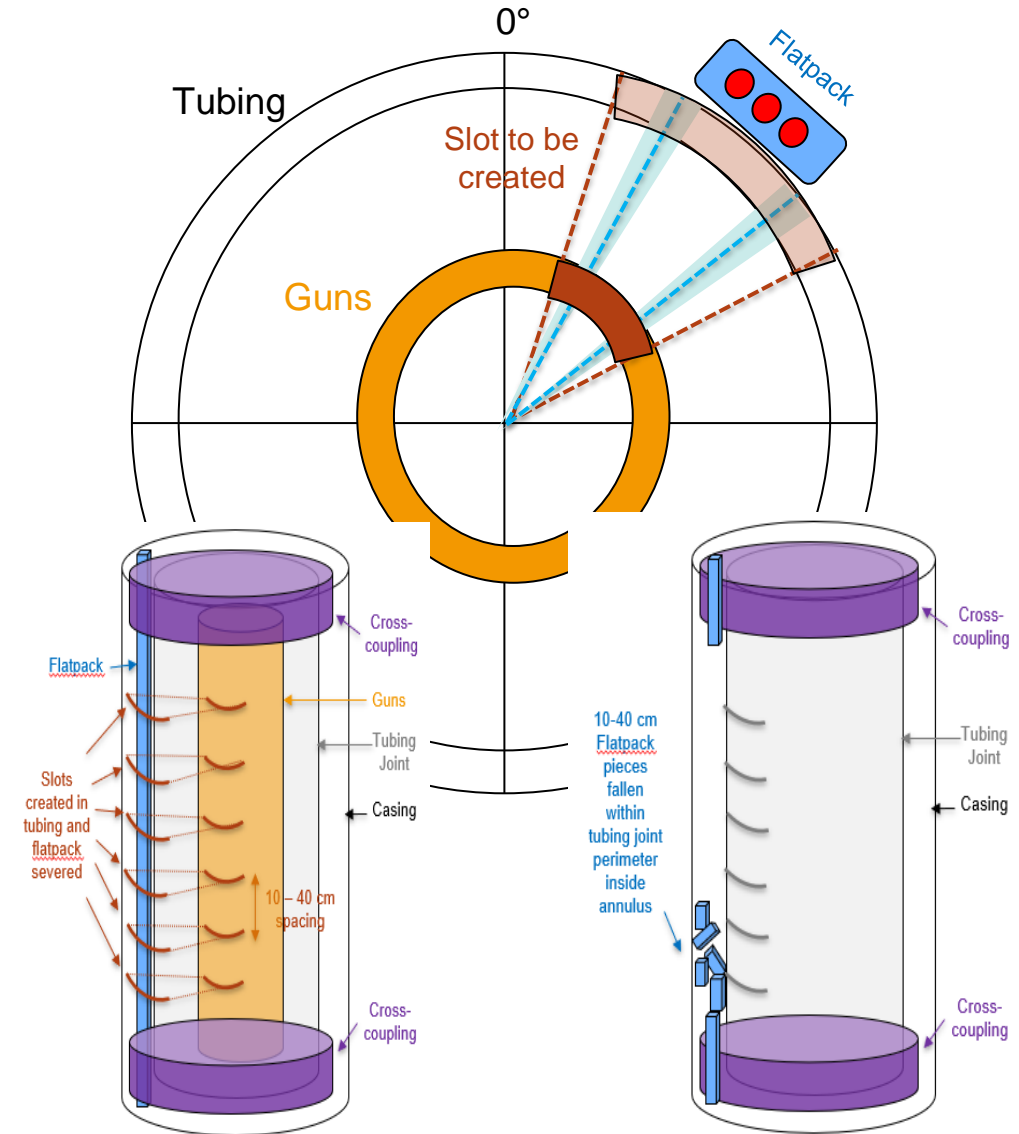
SIT Objectives

A. Flatpack detection & ablation

- Measure position (toolface) of flatpack with e-line tools (ultrasonic & EM).
- Ablate flatpack with DynaSlot charges. 2 designs was tested.
 - Oriented guns
 - Helix guns covering 360° (no orientation required).

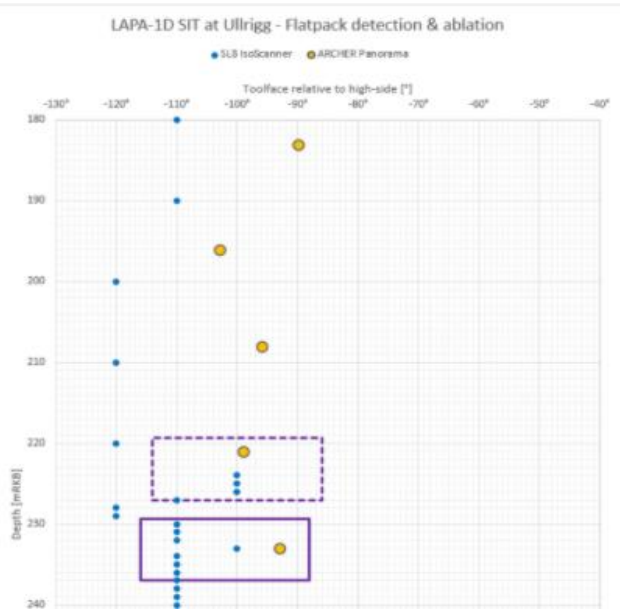
B. Cement Job

- Wash & Cement on Coiled Tubing, with HydraWell tool.

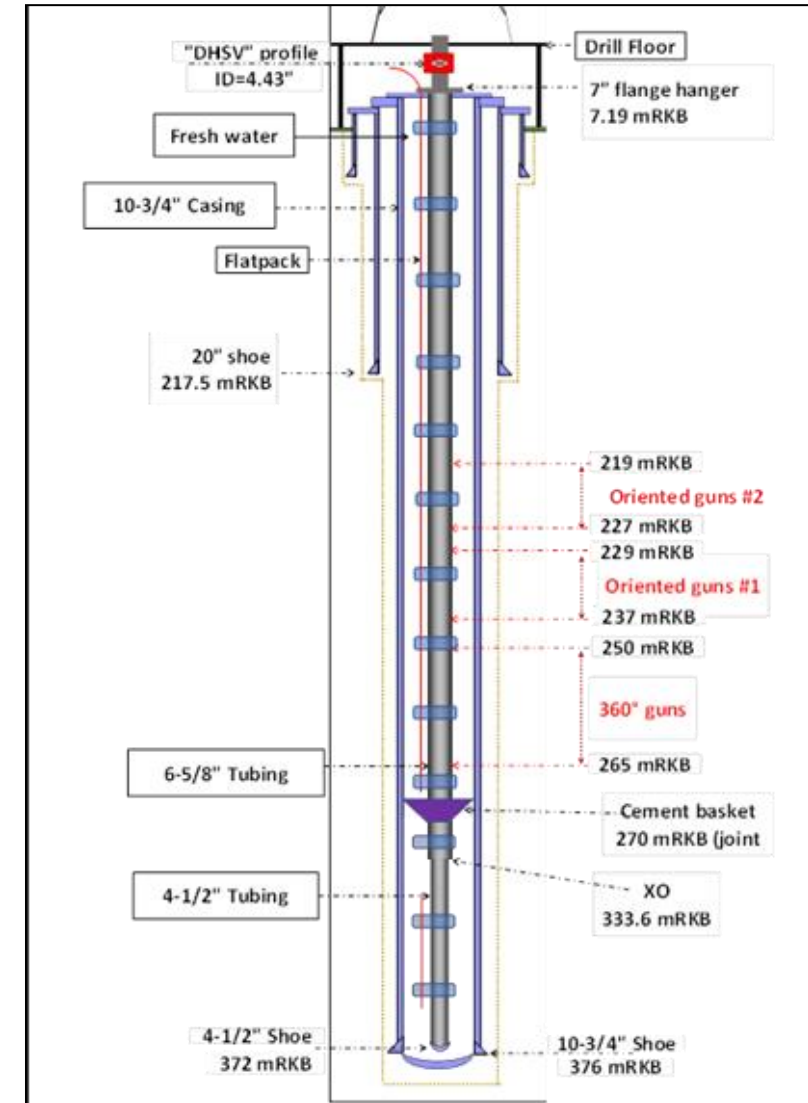


LAPA-1D SIT Setup

- 3 runs with DynaSlot guns:
 - 1x run with 360° charges (corresponding to ~1.5 Helix pattern).
 - 2x runs with oriented charges.
- Charges are the same on all runs, only their placement in the carriers differs.



Company	Tool Name	Detects	6 5/8"	4 1/2"
Schlumberger	Isolation Scanner	Flatpack	X	X
Archer	VIVID	Clamp	X	
GoWell	EM	Clamp	X	
Aarbakke	MTC	FP & Clamp		X



PWC on Coil – The Challenges

- Loss of Rotation from Surface
- Limited flowrate – reduced from ~10 bpm to ~2.5bpm
- Through-tubing o.d. restrictions eliminates use of cup-based approach

The Solution

- Jet-based PWC assembly
- Rotating nozzle head
- Rotation controlled by pre-set hydraulic Brake: 10 – 150 rpm

Application

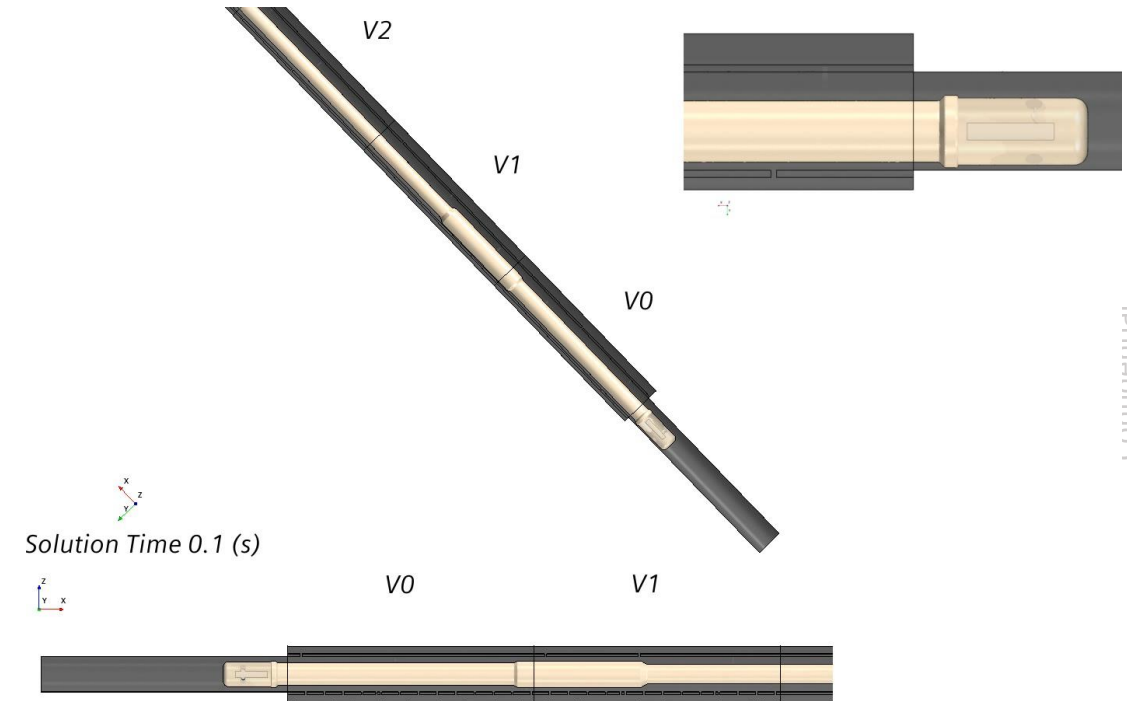
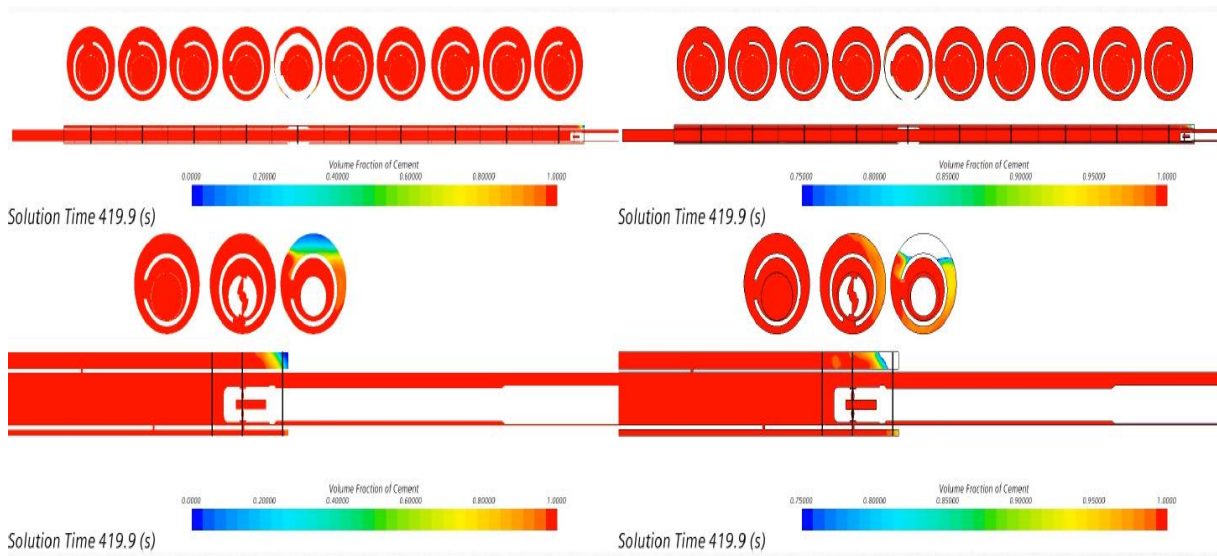
- Tubing Sizes: 4-1/2", 5", 5-1/2" & 6 5/8" and larger
- Min. tool OD: 3,6"
- Flow rates: 2-5 bpm (300-800l/min)
- Coiled tubing size: 2" - 2 7/8" and larger



CFD Modelling for Optimized Cement Displacement

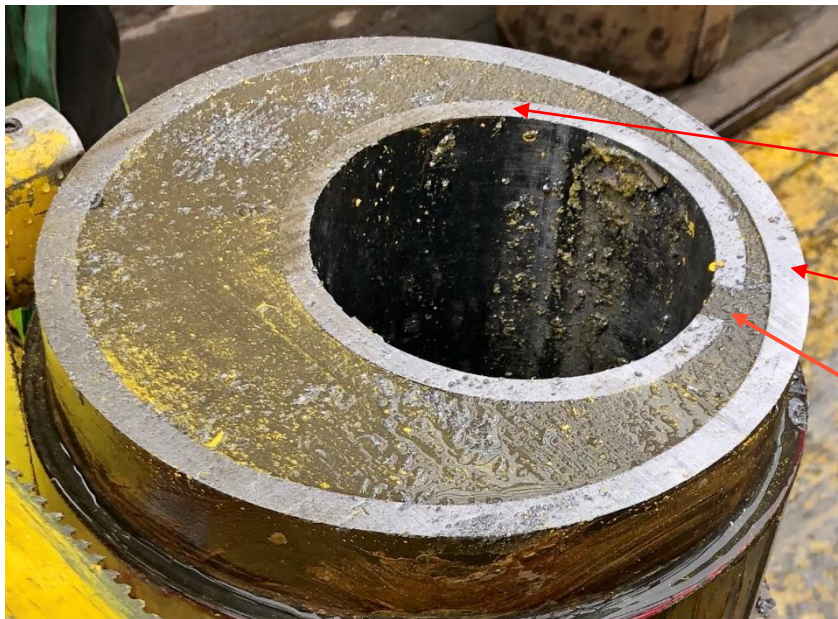
Objective to optimize and ensure correct displacement parameters

Results indicate good cement displacement.



Trial Results

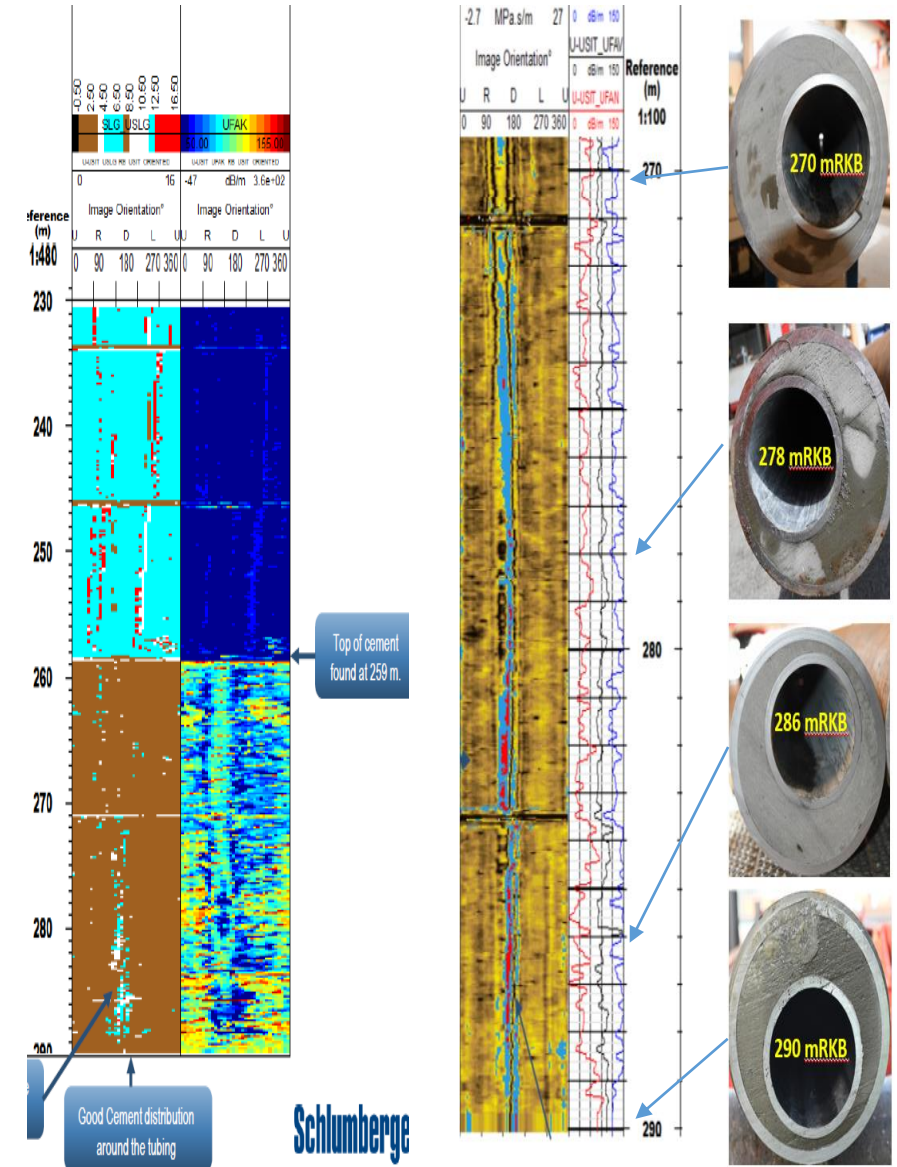
- Drilled hard cement thru entire cemented interval.
- Tagged TOC at planned TOC
- Isolation scanner used to log Cement bond.
- Retrieved and cut joints fully cemented in cross section.
- Near-by 2nd casing affects log signal, artefact referred to as galaxy pattern.



6 5/8" Tubing

10 3/4" Casing

Slot perforation

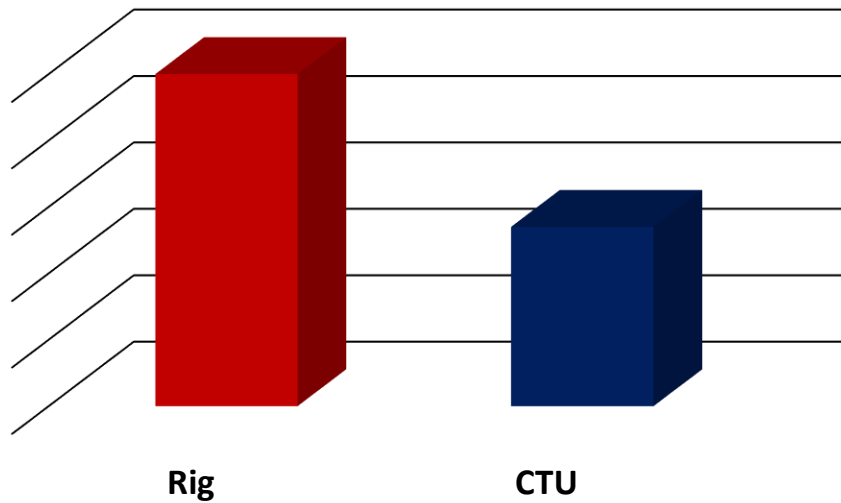


Confidential

Impact of Operations on Coil

Cost Savings

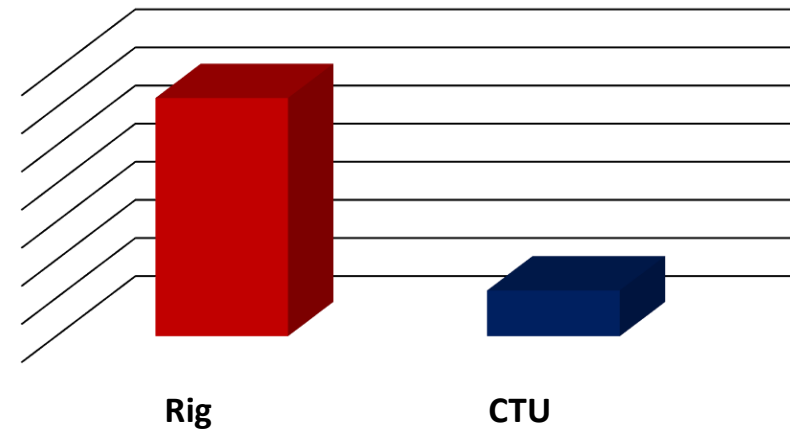
Example Cost Reduction



47% Overall Cost Reduction for typical spread rates and operational durations

Emissions Reduction

Example Reduction in CO2 Emissions



80% Overall Emissions Reduction for typical fuel useages and operational durations

Conclusion

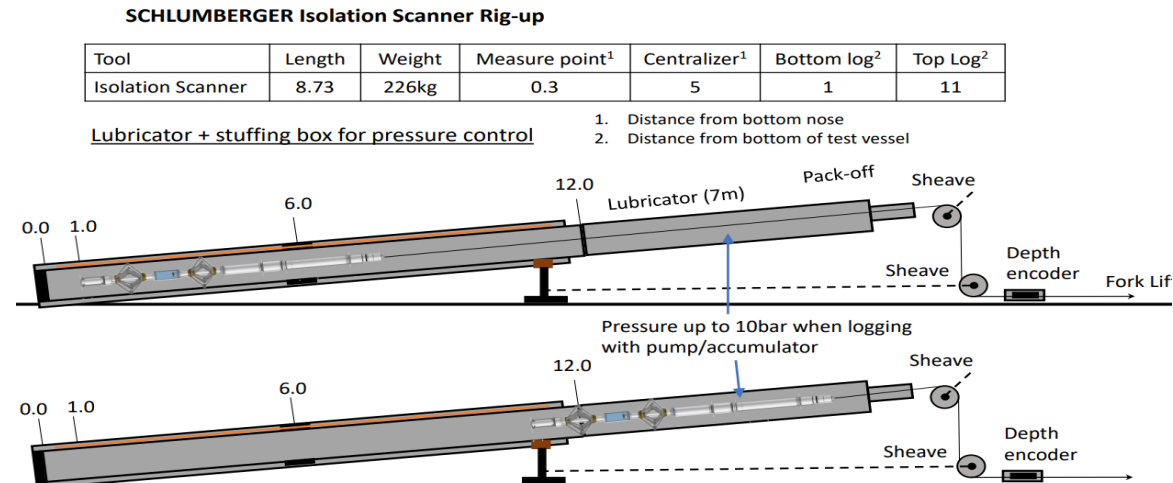
A. Flatpack Detection & Ablation

- ✓ Measure position (toolface) of flatpack with e-line tools (ultrasonic & EM).
 - Achieved and improved phasing accuracy during a follow up test Oct 2021 (5-10 deg)
- ✓ Ablate flatpack with DynaSlot charges. 2 designs was tested:
 - Oriented guns
 - Helix guns covering 360° (no orientation required).

Proved the ability to ablate/cut the flat pack. However more testing is required to improve accuracy, phasing and accurate gun charge energy (10 ¾" casing integrity failed).

B. Cement Job

- ✓ Wash & Cement on Coiled Tubing, with HydraWell tool.
 - Successful test of CT cementing with new PWC. Stand off tool recommend to ensure 100% cement coverage.



Summary

De-risked the Lapa 1-D operation !

Successful CT through tubing operation and PWC.

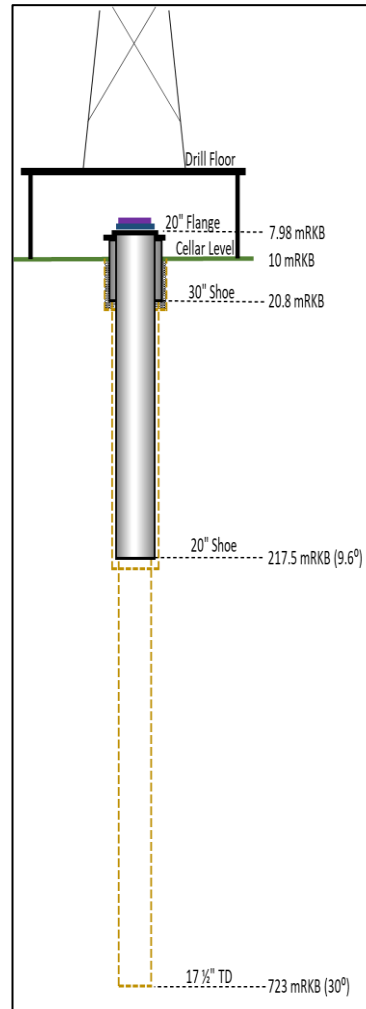
Valuable data retrieved (flatpack detection and ablation)

NORCE & Ullrigg facility

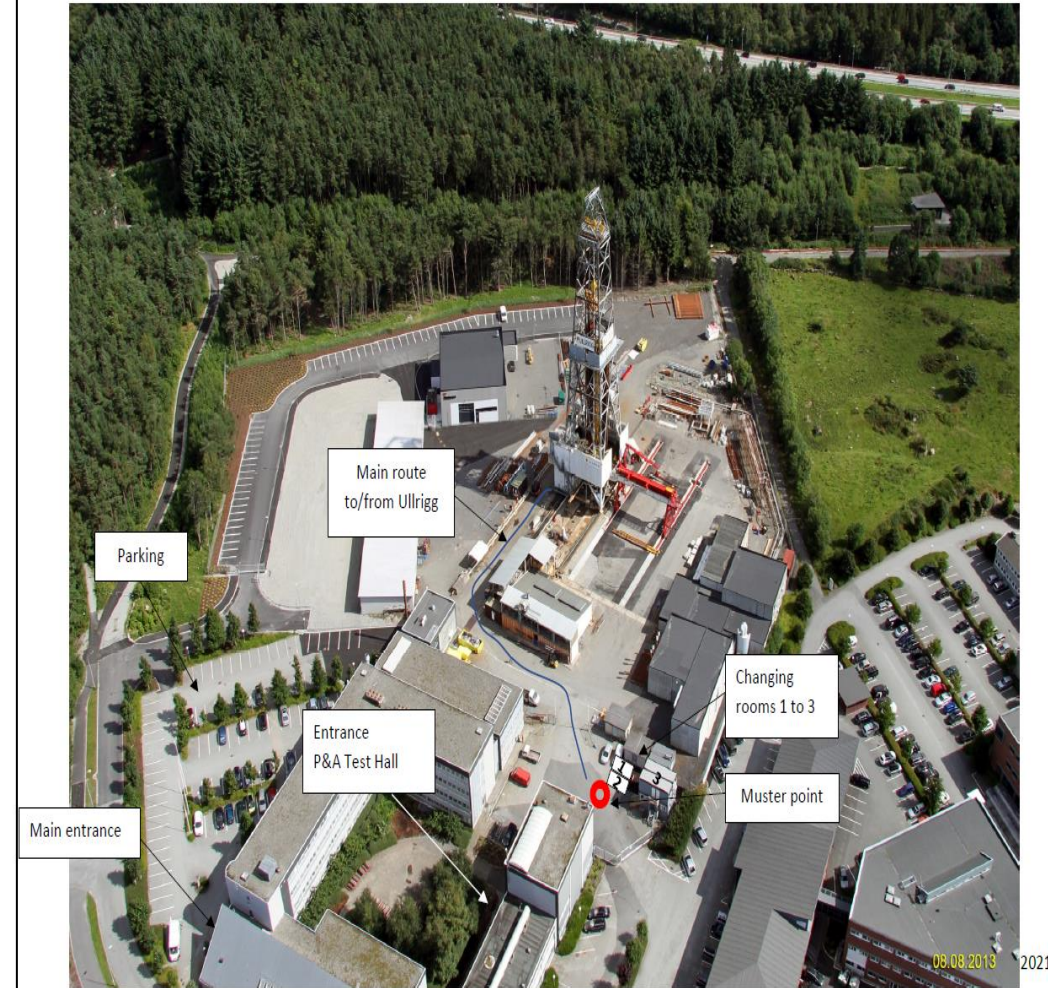
- **skilled personnel and excellent service!!**

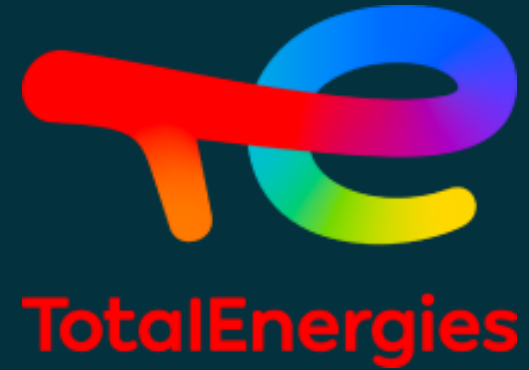
Collaboration is key !!!

Ullrigg U8 P&A well



NORCE Ullrigg test facility





Thank You

Questions and Discussion