



Sustainable Sand Management Control and Solutions - Balancing Performance, Costs, and Environment

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A Multi-pronged and Robust Approach to Deliver Cost-effective Production Enhancement Activity in Field T

Ruzaini Shahrom, Adib Akmal Che Sidid, Zulkifli M Zin, Hafidz Alamsyah, Gary Ngu,
Maurice Polycarp, Ainur Husna Sulhi

PETRONAS Carigali Sdn Bhd





Content of Presentation

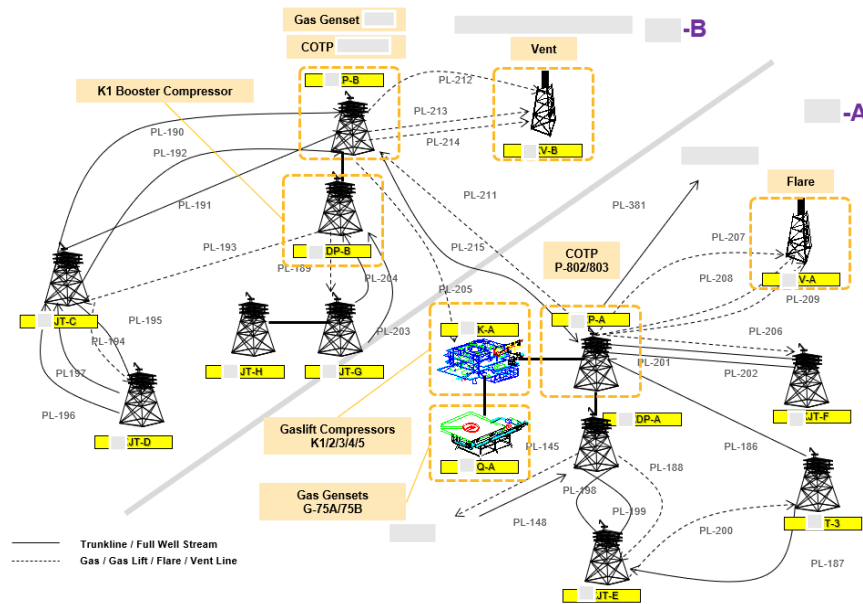
- Objective
- Problem Statement
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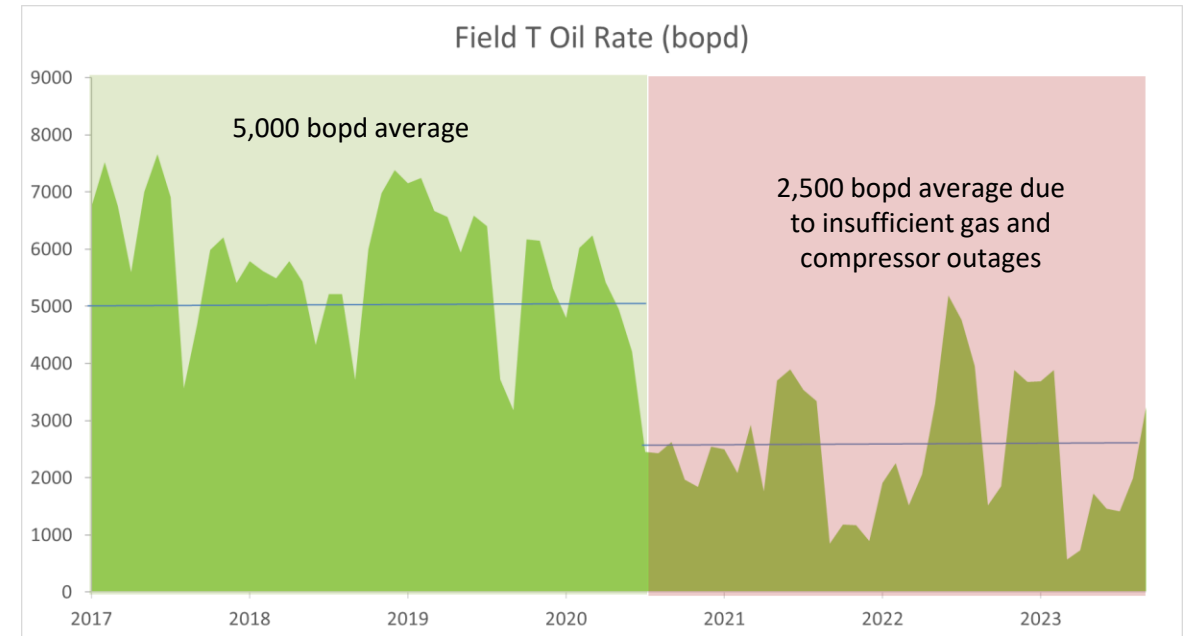
Objective

- To share a case study where a production enhancement activity was delivered despite technical and commercial challenges
- To discuss findings and seek feedback from peers

Problem Statement



Layout of platforms on Field T

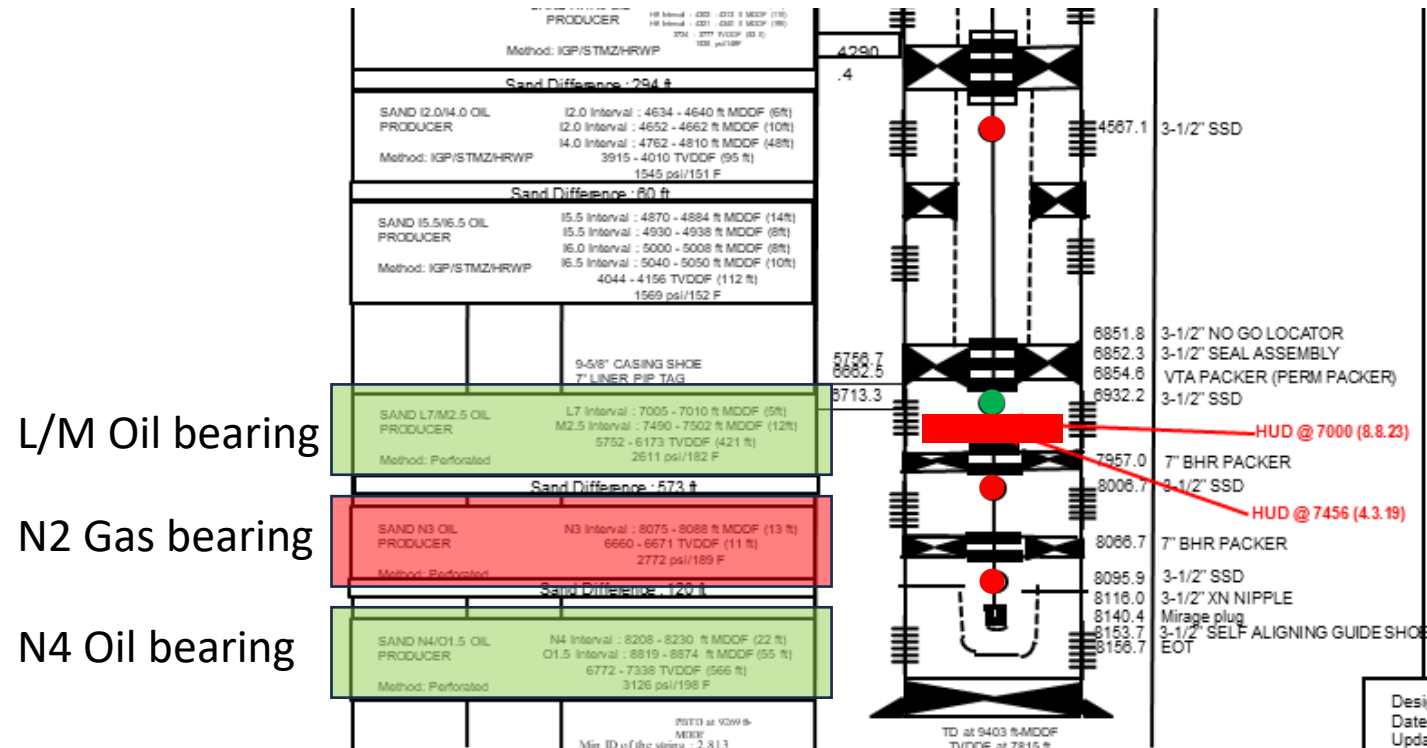


Step change in Field T output

- Inability to reinstate production half of the well stock, due to insufficient gas for artificial lifting
- Deferment of 2,500 bopd

Enabler

- Identification of gas bearing zone, currently inaccessible due to accumulation of sand in tubing



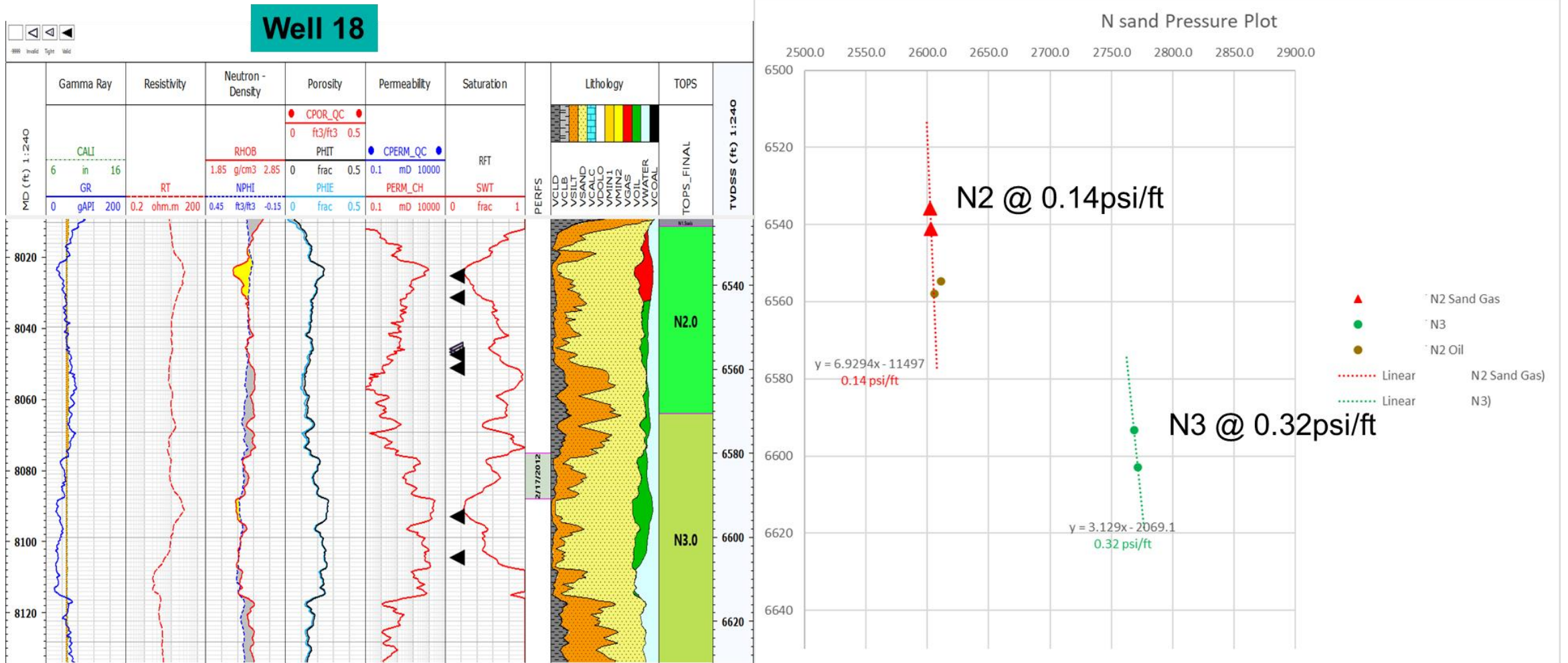
Zoom-in of completion diagram, showing the different production zones completed on Well 18



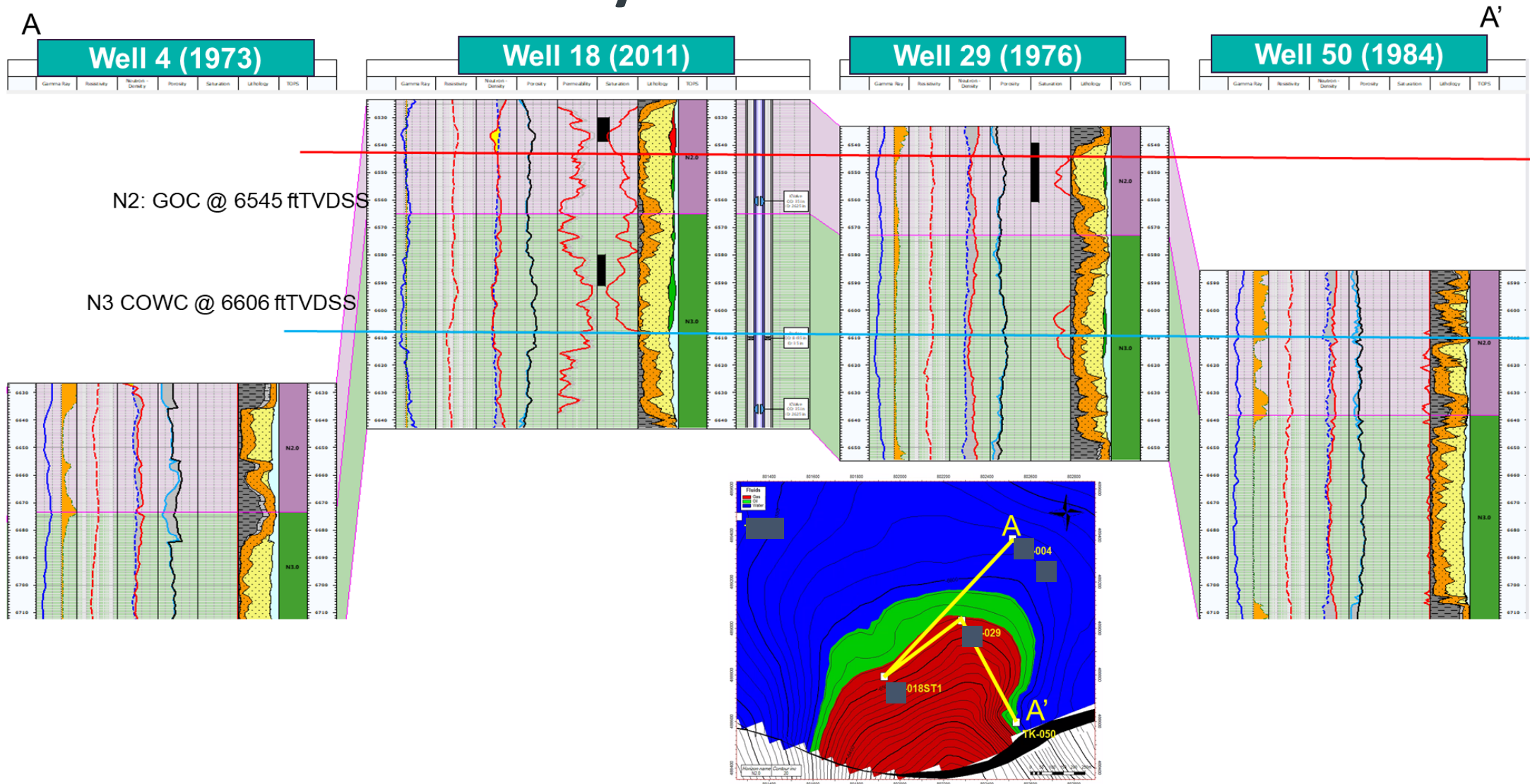
Challenges

1. Subsurface uncertainty- size of remaining gas reserves
2. High cost related to CTU operation
3. Potential redundancy- separate gas opportunity (Well 42) in the field

Subsurface Uncertainty- Presence of Gas from RFT



Subsurface Uncertainty- Extensiveness of N2 Sand



Subsurface Uncertainty- Remaining Gas

Sand	Allocation by KH		Allocation by H only	
	KH* (md.ft)	Gp (Bscf)	H (ft)	Gp (Bscf)
M5	4007	2.24	82	1.30
N1.5	654	0.37	46	0.73
N2	205	0.11	39	0.62
N5	1565	0.87	59	0.94
Total		3.59		3.59

Comparison of zonal allocation using KH vs using H only, to provide a conservative estimate of cumulative production from N2 sand

Zonal contribution estimate of another N2 producer Well 29

- Uncertainty due to lack of zonal contribution data on existing producer Well 19
- Remaining gas reserves ranges between 0.4 to 1.0 Bscf
- At estimated rate of 2 mmscfd, the ROP could last between 200 to 500 days

Solution

Challenges

1. Subsurface uncertainty- size of remaining gas reserves
2. High cost related to CTU operation
3. Potential redundancy- separate gas opportunity (Well 42) in the field

Well 18 CTU
SCO

SCO until EOT

Well 18 flow new oil
zones N4

While waiting for Well 42
outcome. Perforated N4
zones but never been
produced



NO

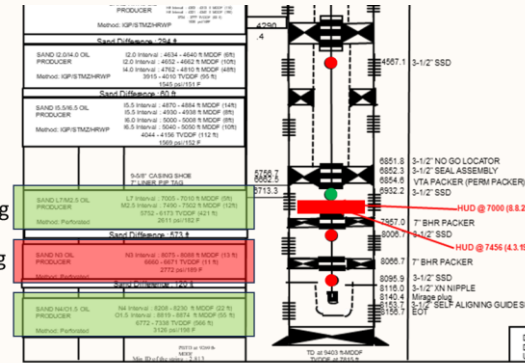
Well 18 add
perf gas zone
N2

Reinstatement
of Sector B
+2,500 bopd IWR

Future PE-ZOC
opportunity
from N4

Opportunity to be
considered once a long-
term gas solution is
secured

L/M Oil bearing
N2 Gas bearing
N4 Oil bearing



YES

Reinstatement
of Sector B
+2,500 bopd IWR

Well 18 cont
flowing new oil
zones N4

**+410 bopd production
enhancement,
acceleration of reserves**



Minimal scope on CTU+barge

CTU with Work Barge



Slickline without Work Barge

Result- Operations 2/2

A



B

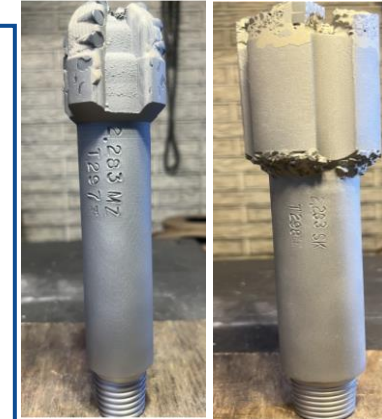


CTU Sand Cleanout



- **Multijet Nozzle** : 1047ft sand cleanout within 3 days. **⚠️ Slow penetration observed with fine sand recovered at 0.01% to 0.6% (BSW)**
- During pressure cycle, observed Tubing Head Pressure (THP) is not holding. **✅ Suspected Mirage Plug already expanded**
- **High Pressure Jetting Nozzle (Spincat)**: 15ft debris cleanout within 3 days. **⚠️ Slow penetration & CT weight loss observed**
- **Mill Bit (PDC Mill)**: 41ft depth penetration within 1 day. **⚠️ No further depth penetration observed**
- **Mill Bit (Bladed Convex-Carbide)**: 3ft depth penetration within 1 day. **⚠️ Mill bit stalling & metal debris observed at surface**
- **Venturi Junk Basket**: 1ft debris cleanout within 2 days. **⚠️ Venturi Junk Basket bottom part plugged with very fine & wet debris**

TOTAL SAND/DEBRIS CLEANOUT = 1,089FT



C

D

Lesson Learnt

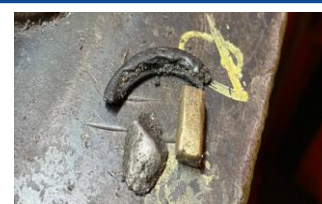
- **Nozzle design**: Custom design on nozzle's orifice to have larger outlet for better increment of pumping rate to prevent sandface erosion at the nozzle outlet.
- **Flowback rigup** : High pumping will give higher FTHP. Sand/liquid flow erosion to the flowback equipment can be eliminated with multiple bridging elbow.
- **Venturi Junk Basket design** : Redesign to eliminate friction at the mid section to allow sand flow easily to the extension part of VJB. Selection of the better finger (flapper vs flutter cage).



I



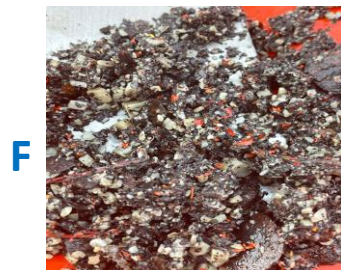
H



G



E

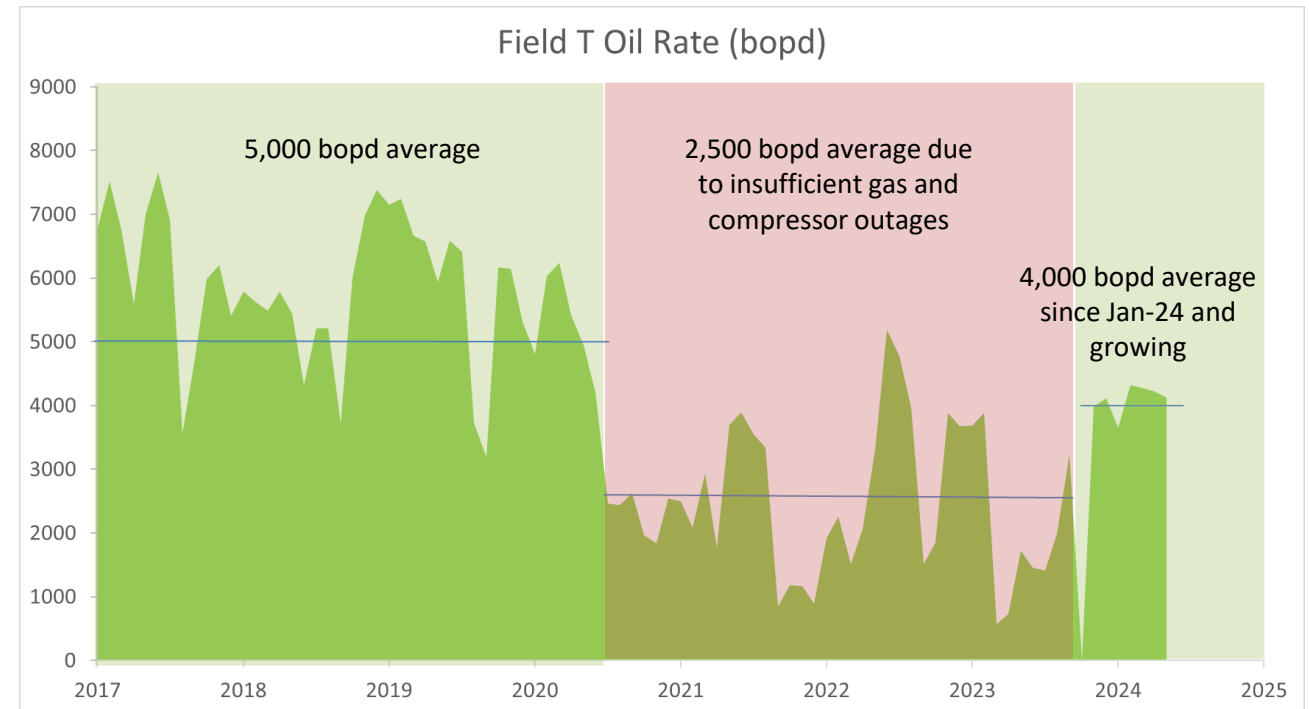


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Result- Value Delivered





Slurry debris/sand recovered from CTU clean-out



Notable production improvement following delivery of N2 gas from Well 18

- Reinstatement of +1,500 bopd, payback of 1 month
- Enabled backlogs of deferred production enhancements to be realized
- Well 18 is monitored for potential sand production, sand free to-date

Result- Analysis of Downhole Sample

Item	Slickline sand bailing sample (Pre-CTU)	CTU sand clean-out sample
X-ray Fluorescence (XRF)	XRF: Major element found to be Si (78%) indicating that the main content of sample to be sand	XRF: Major element found to be Fe (52%) suggesting that the main content of sample to be iron products
Sample Photo		
LPSA	Dv10 of 80 micron, fine sand	N/A

Discussion

1. What is the true nature of the HUD- sand or tubing product?
2. What could have been done to improve unit enhancement cost (UEC) of similar activity?
3. What could have been done, in retrospect, to minimise the need of high UEC intervention throughout well life?



Thank you

The Authors would like to thank PETRONAS Carigali Sdn Bhd for allowing sharing of this presentation

