



Carbon Storage and Management

3–4 SEPTEMBER 2024 | KUALA LUMPUR, MALAYSIA

Applications of Cement Evaluation Through Two-Tubulars for Oil, Gas and CCS Wells

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SLB

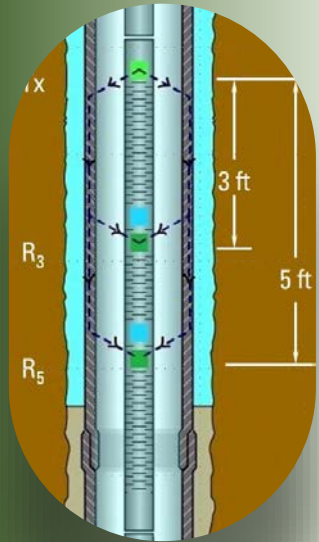


Agenda

- Cement Evaluation Through Two Tubulars
 - Technology Evolution
 - Challenges – Pipe Eccentricity and Annulus A Material
 - Correction – Pipe Eccentricity and Annulus A Material
- Level of Answer Products
- Case Study Example

Traditional Single-String Barrier Evaluation

Acoustic

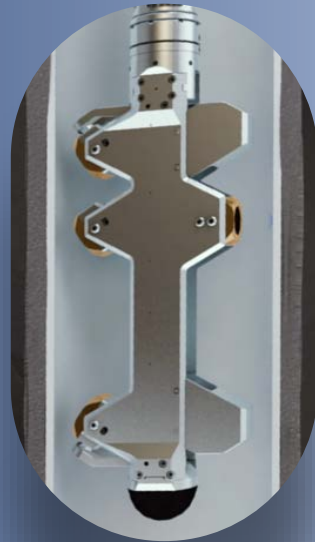


○
1960

Ultrasonic



○
1993



○
2006



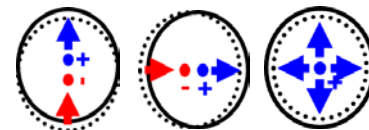
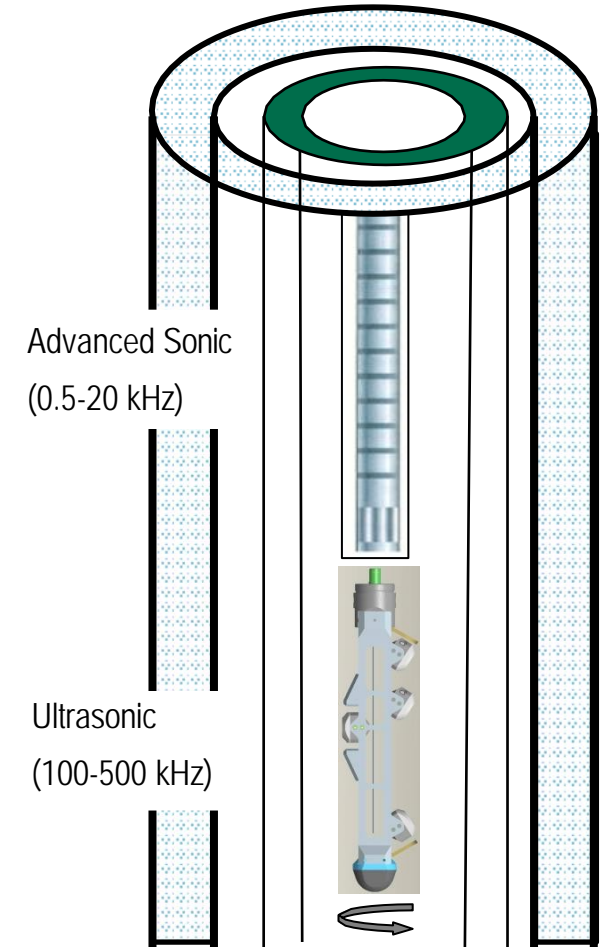
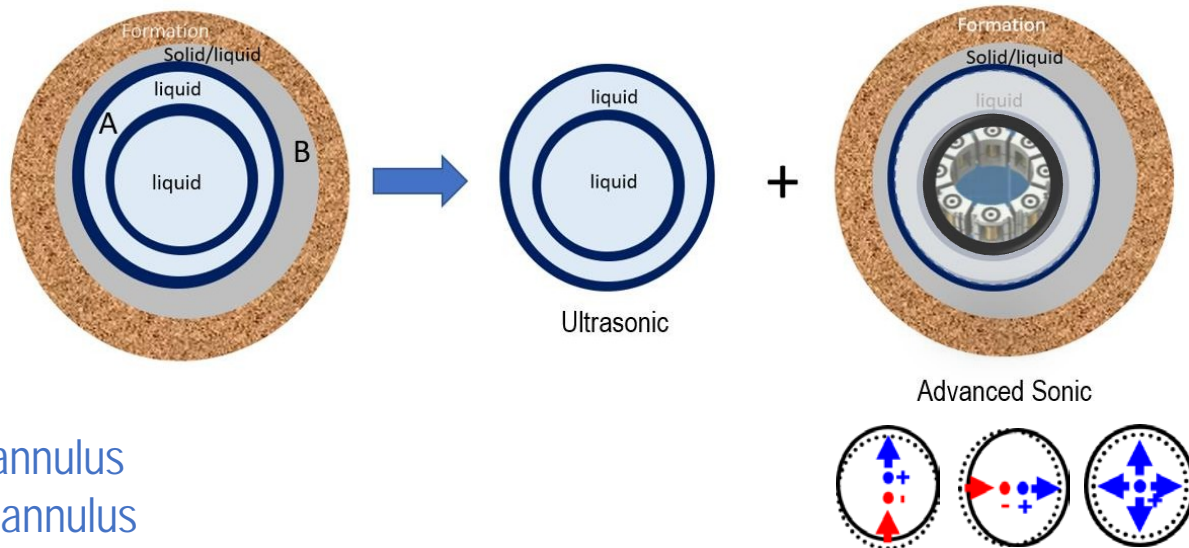
○
2017

○
2022

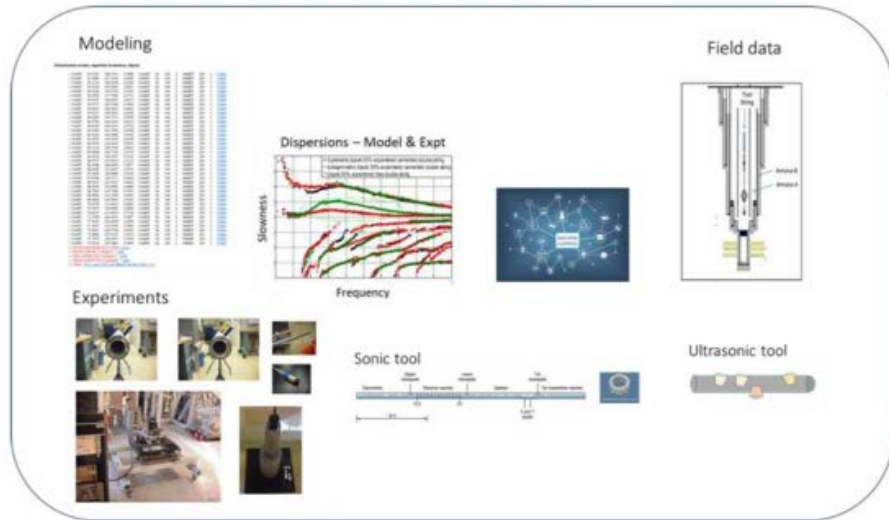
Challenges

- Two pipes
- Two wellbore fluids
- Pipe to Pipe positing (Geometry)

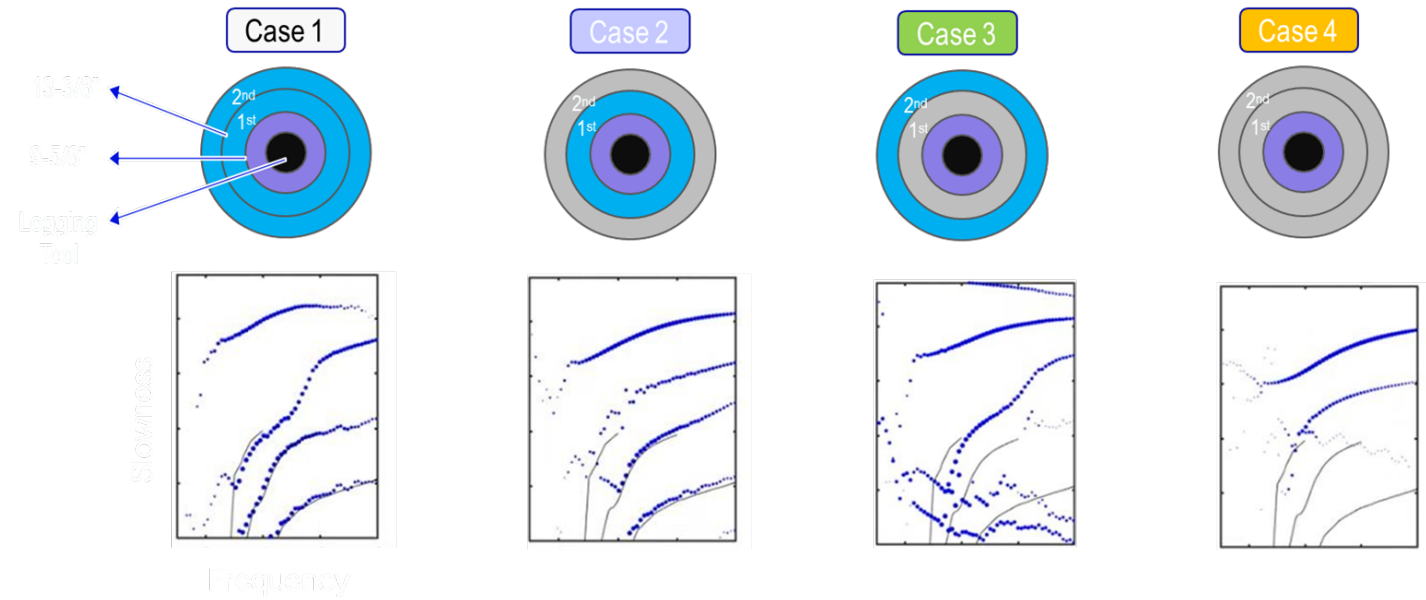
Approach



Std Tool Field Trial 2018-2022



Modeling Example



Pipe-to-Pipe Position makes any Difference?

A Liquid, B Solid

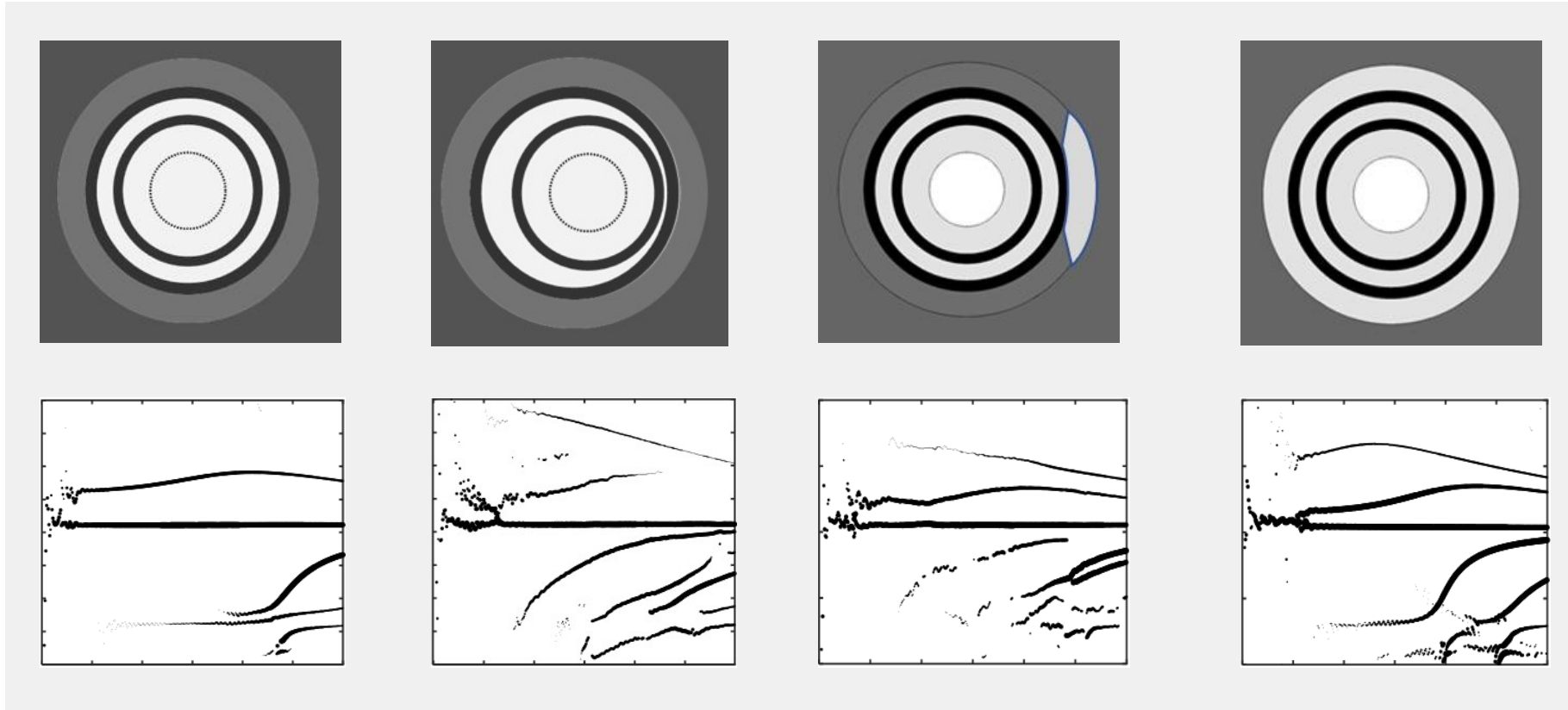
A Liquid

Centered

Eccentered

B Solid w/channel

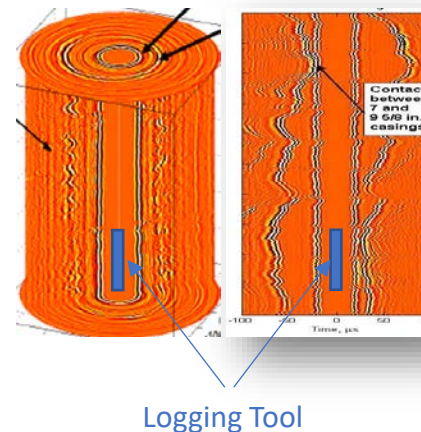
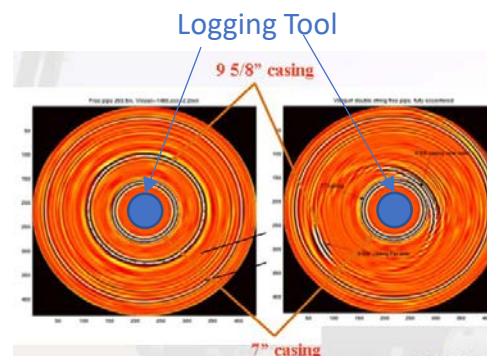
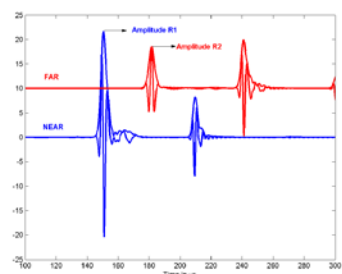
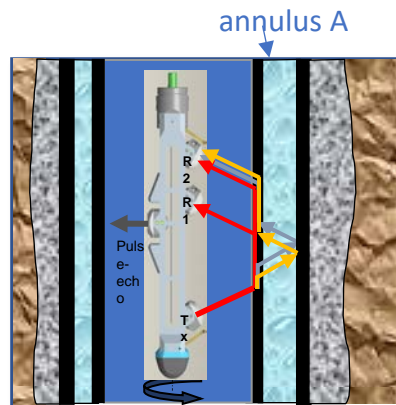
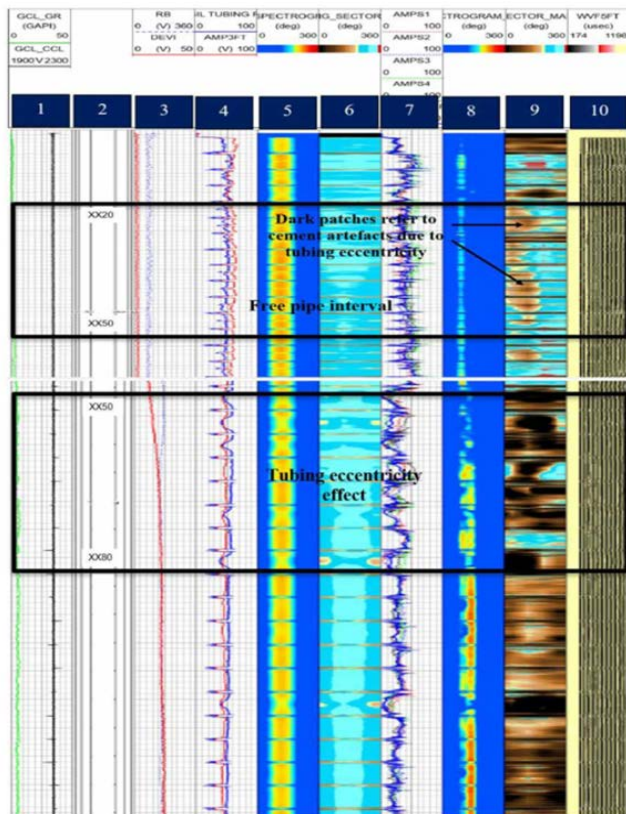
B Liquid



The figures above illustrate the importance of pipe-to-pipe position in the 2nd annulus evaluation, and not knowing the position may cause uncertainty in the answer. The position is determined using ultrasonic TIE (Third Interface Echo) physics

SPE-210699-MS Redefining Well Abandonment Strategy: Tipping the Scale Towards Greater Cost and Operational Efficiency Through a Novel Multi-Layer Steel Barriers Cement Bond Logging

Sonic Based Tool is affected by Tubing Eccentricity Effect – M Field Example



Annulus A Material and 1st Tubing Eccentricity

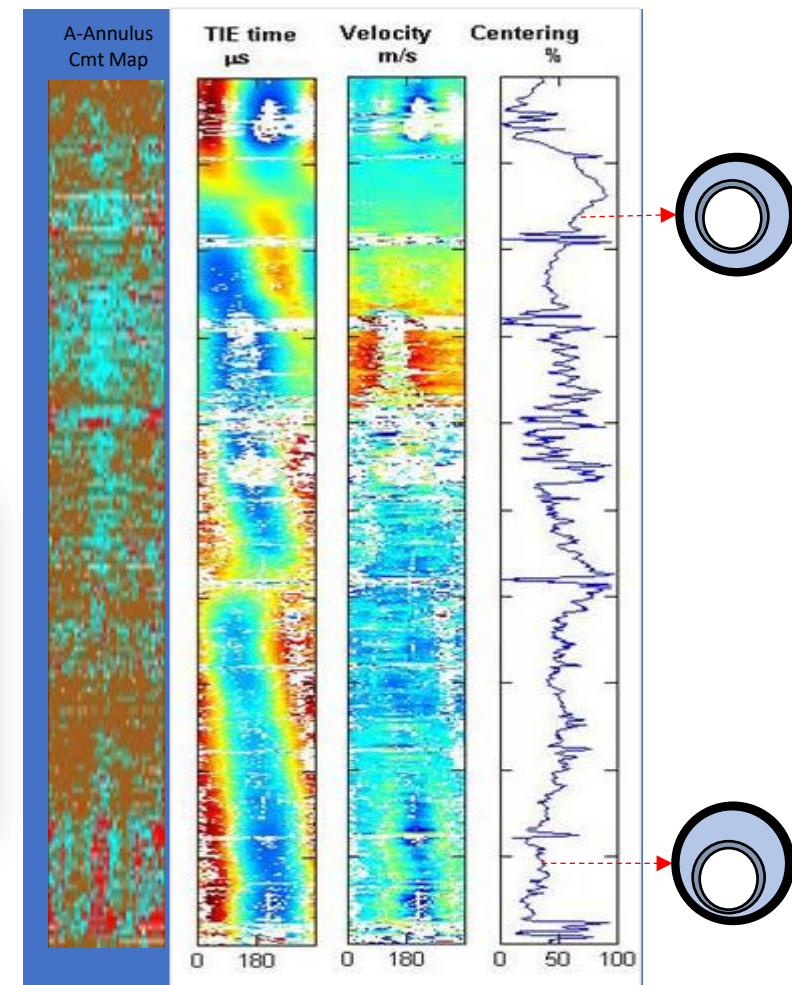


Figure 8—Overall results of CBL trial tool in well X (1-Gamma Ray, 2-measured depth in feet, 3-well deviation (DEV) and relative bearing (RB), 4-tubing time domain (AMP3FT) and frequency domain (TUBING_THREE_FEET) amplitude, 5-tubing frequency spectrum, 6-tubing sector map, 7-casing amplitude, 8-casing frequency spectrum, 9-casing sector map, 10-variable density log (VDL).

Physics based

Level	B-Annulus Deliverables	Radial Direction	Correction Type
1	Basic bond index 		—
2	Corrected bond index 		Environmental
3	Segmented bond log 		Environmental
4	360° azimuthal map 		Formation, environmental

Client

→ ADNOC

Objective

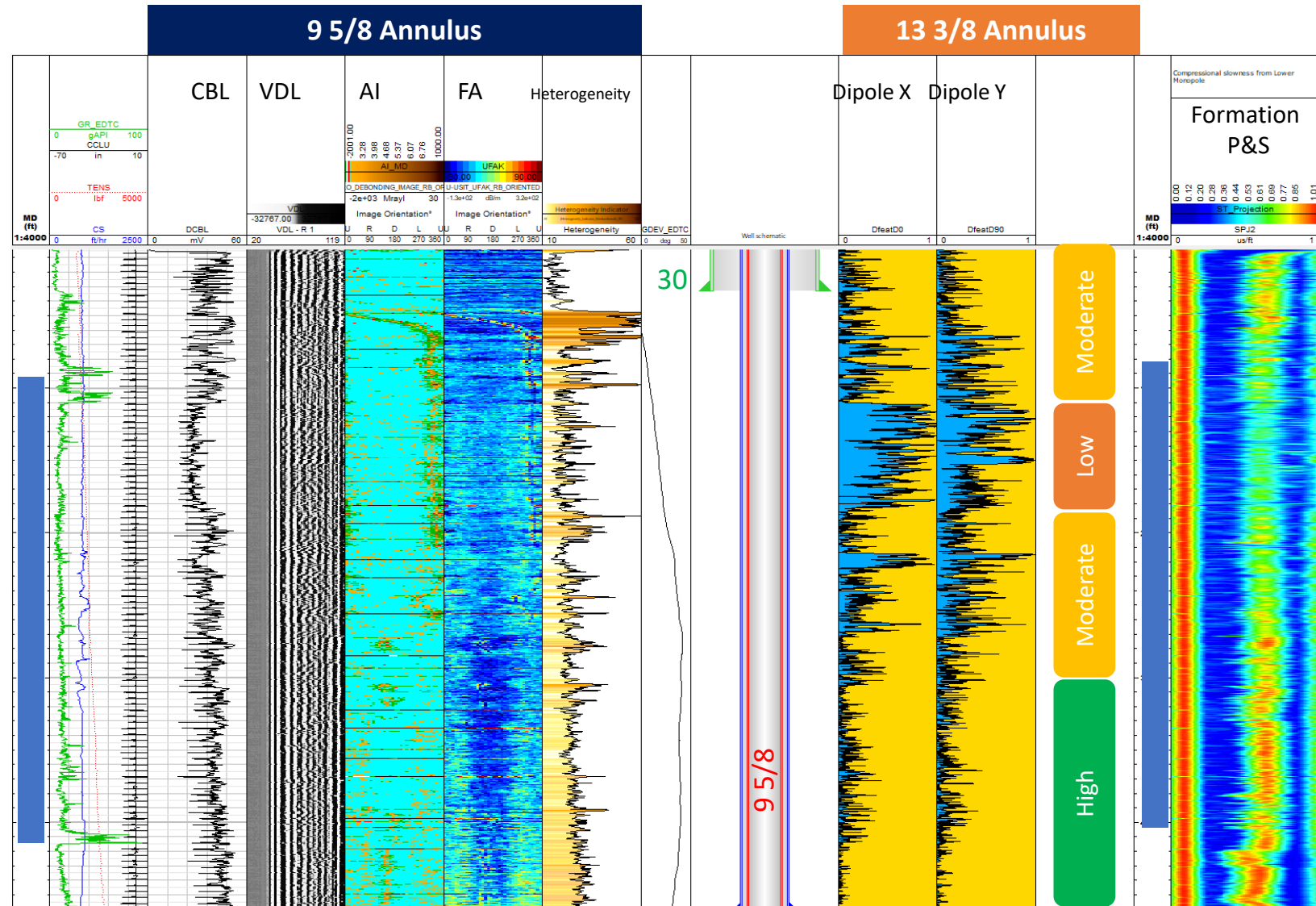
→ Sidetrack the well

Challenges

- Unknown barrier condition of 9 5/8-in & 13 3/8-in
- Evaluate possibility of casing contact around whipstock depth

Result

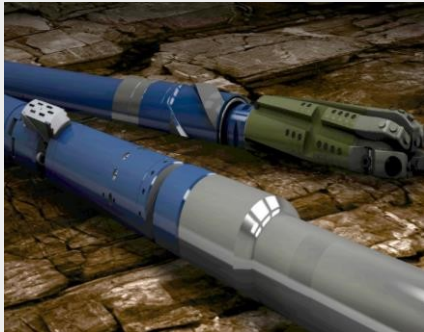
- Bond quality confirmed across the zone of interest
- Formation P&S data acquired



Value Creation – slot recovery



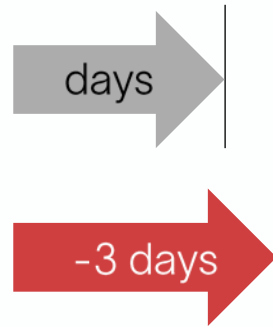
Insights to actions



Enabled client to create an optimal well sidetrack plan



Optimized operation



Saved 66 hours of rig time (~USD 0.5 million)



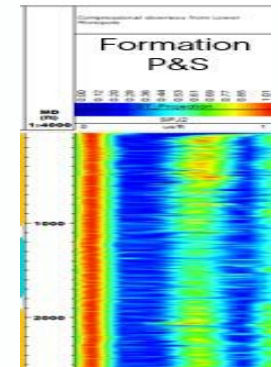
Sustainable execution



Reduced scope 1 emissions by 71 metric tons of CO₂e



Beyond barrier evaluation



Formation P & S data are acquired—adding value to customer for reservoir characterization

Client

→ Eni

Objective

- Plug and Abandon (P&A) two wells per NSTA regulations while ensuring suitability for future CO₂ storage
- Improve efficiency and sustainability at the lowest cost

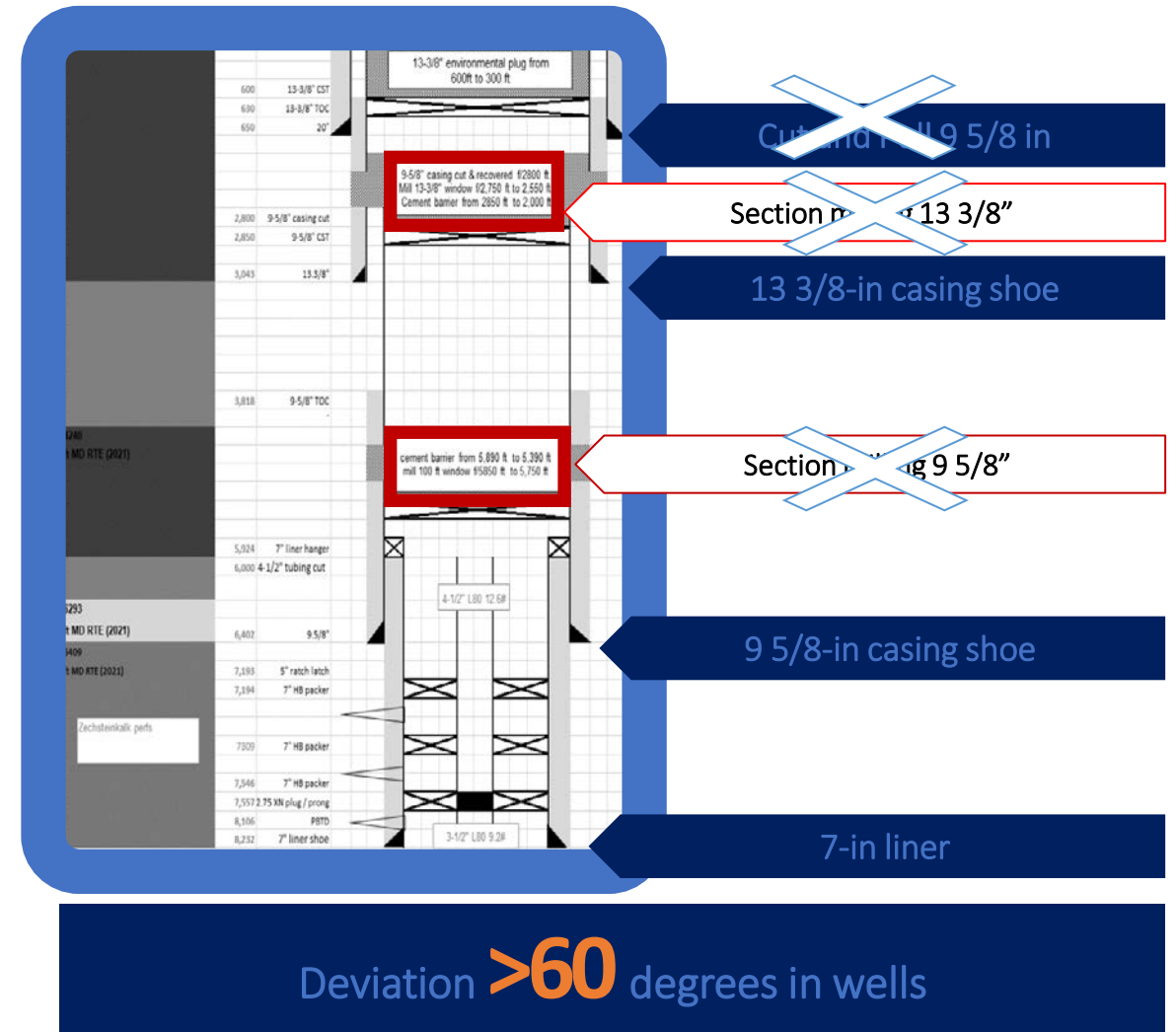
Challenges

- Elevated risk due to poor cement job and high deviation
- Multiple uncertainties leading to costly contingency

Result

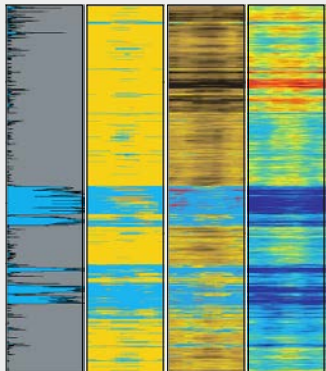
- Optimum environmental cap positioning for rock-to-rock barrier
- 42 rig days saving (~USD5M)
- 670T CO₂e reduction

Initial P&A Plan

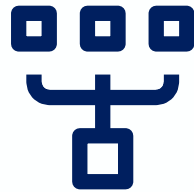




Insight to Actions



Provided customer with optimum depth to place the environmental cap



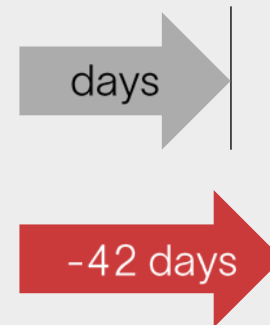
Derisk project



Eliminated 4 section mills and fishing operations



Optimize operations



Saved >42 days of rig time (~USD5M)



Sustainable execution



Reduced scope 1 emissions by 670 metric tons of CO₂e

Client

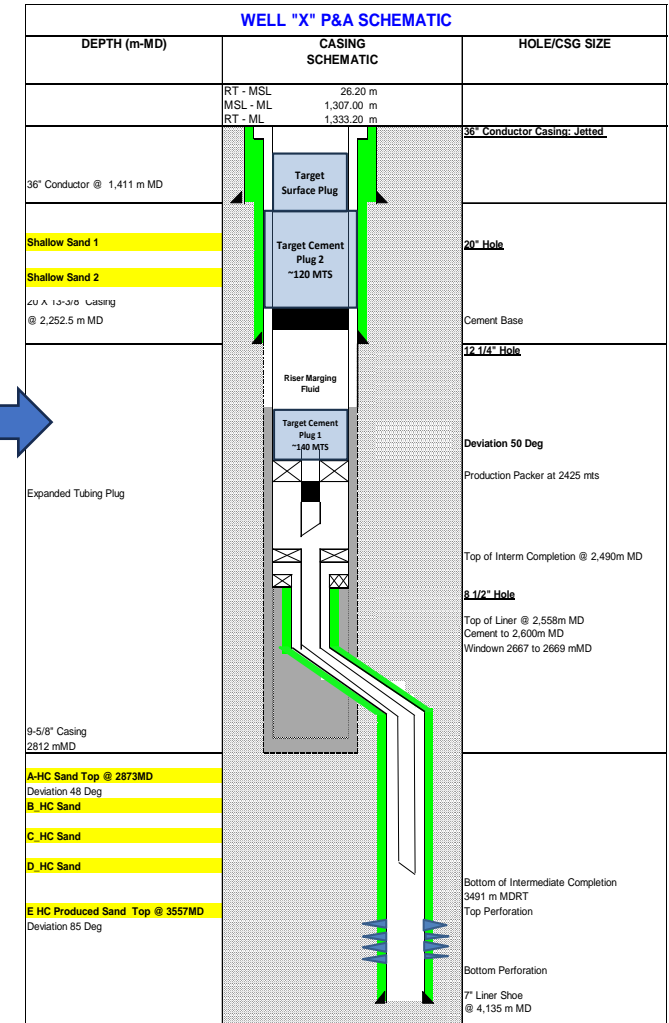
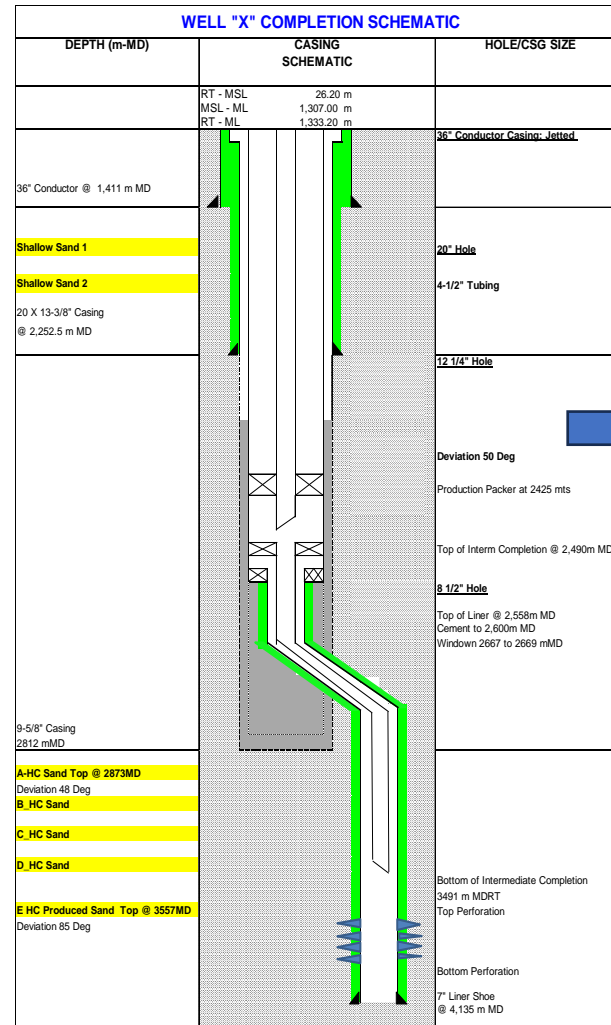
→ PTTEP

Objective

→ PnA Deep Water Well

Challenges

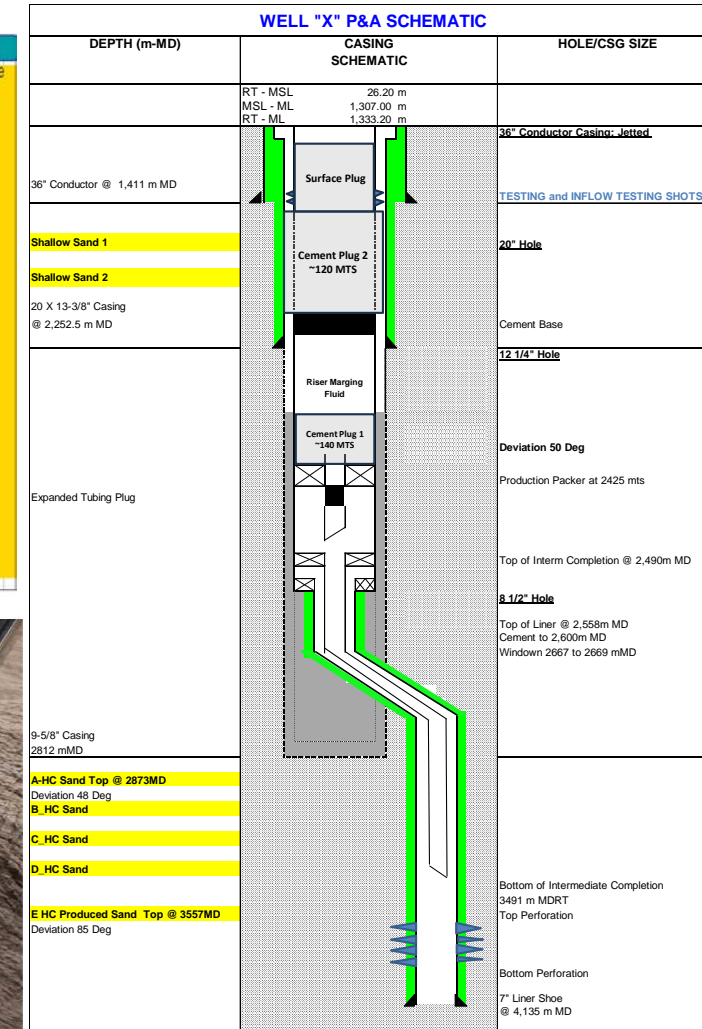
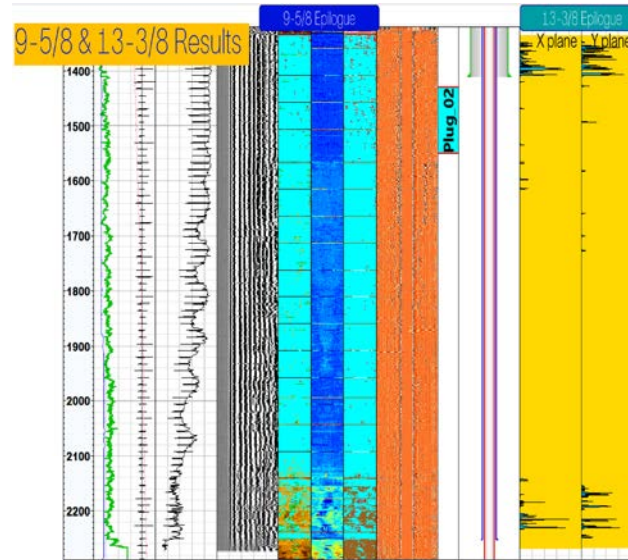
- Well with notorious history of sand production, with expected tubing obstructions.
- Known leaking subsea tree valves increasing the well re-entry complexity.
- Hydrate formation a known risk in the field.
- Plug#1 and 2 targeted at a competent cap rock depth.
- Plug #2 between 13-3/8" and 9-5/8" casing required validation testing post plug placement.
- Surface Plug in close proximity to the Subsea BOP.



Result

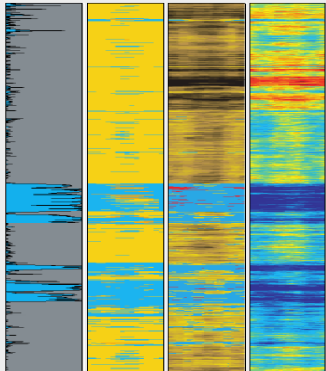
Challenges Conquered

- Campaign executed with zero recordable incidents
- All technical objectives achieved for well “X”
- Complex well barrier re-entry successfully managed
- Zero NPT due to Service partners equipment and services.
- Successful fluid management and hydrate prevention
- Several first-time technology applications for PTTEP Malaysia:
 - Slim hole Mechanical Cutter deployment (Contingency activated for wellbore ID restriction).
 - Dual casing cement bond log (Ascertain fluid behind 9-5/8” casing, Evaluate 13-3/8” Casing cement bonding, Determine casings eccentricity)
 - Specialized Guns for controlled penetration (no damaged to existing well construction, proper flow path for deploying cement plug #2)
 - Single Annuli perforating, washing and cementing in deepwater asset.

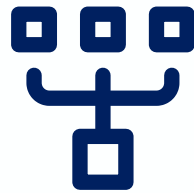




Barrier Insight



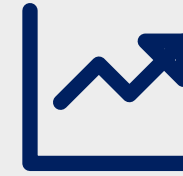
Provides bond quality for two strings simultaneously in a single run



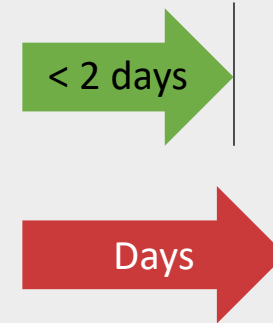
Derisk project



Eliminated 1 section mill & PWC depth refinement



Optimize operations



Over 2 days of Rig time estimated to be saved (1MUSD/day)



Sustainable execution



Reduced scope 1 emissions by 320 metric tons of CO₂e

STD Tool

Inner Pipe

5 1/2, 6 5/8, 7, 9 5/8

Outer Pipe 7, 9 5/8, 10, 10 3/5, 13 3/8

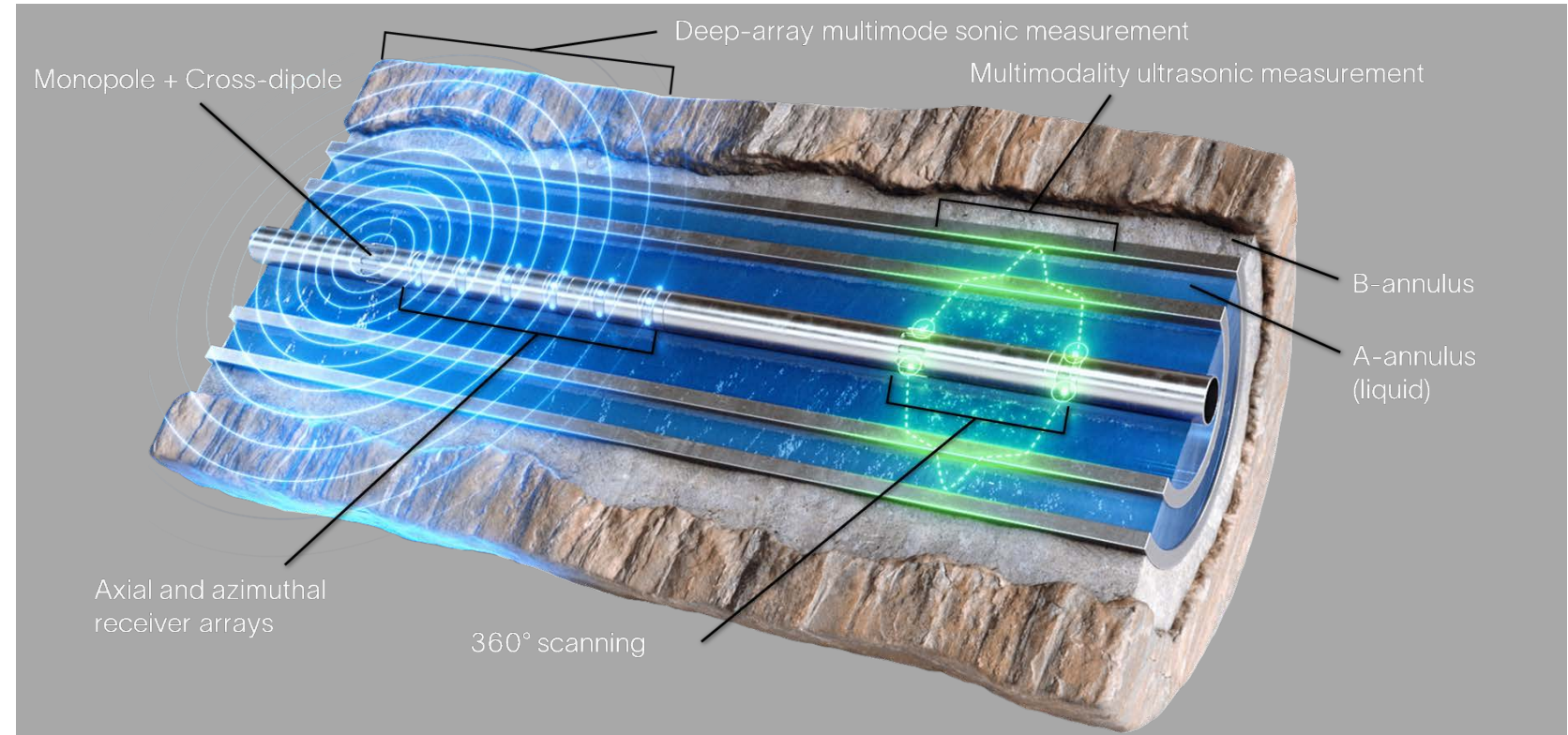
Slim Tool

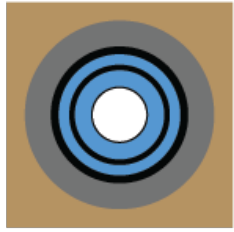
Inner Pipe 3 1/2, 4, 4 1/2, 5

Outer Pipe

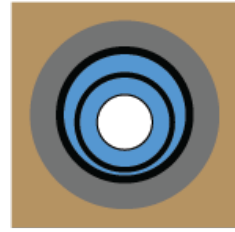
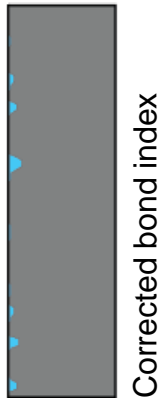
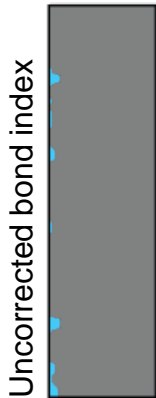
2 1/8 inch OD

6 5/8, 7, 7 5/8, 9 5/8

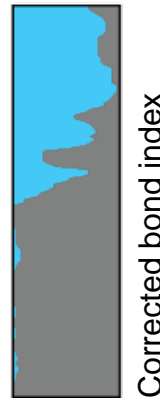




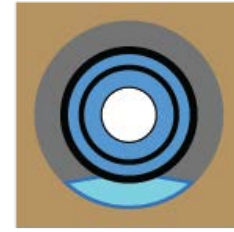
B-annulus solid,
centered tubing



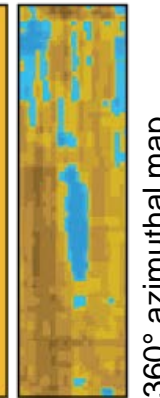
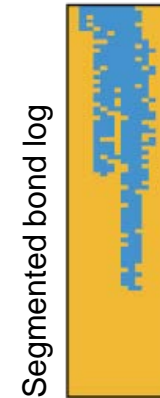
B-annulus solid,
eccentered tubing



Level 1
Answer



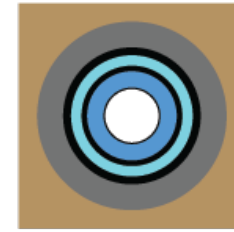
B-annulus
with liquid channel



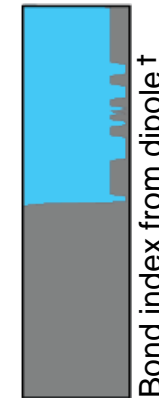
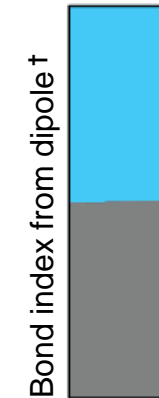
Level 2
Answer

Level 3
Answer

Level 4
Answer



B-annulus solid,
A-annulus liquid change



8.5 lbm/galUS

13 lbm/galUS