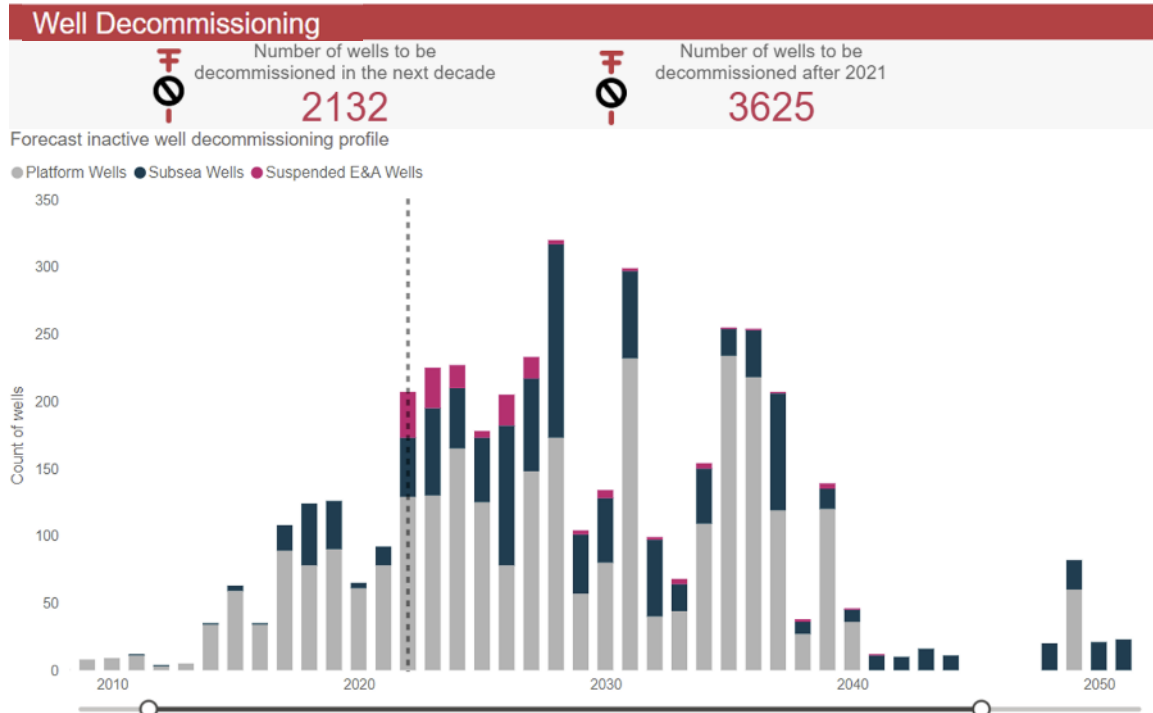


Standardised Evaluation of Cement Bond to facilitate consistent zonal isolation in the abandonment and repurposing of wells

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Welcome



Graph: <https://www.nstauthority.co.uk/media/8441/wells-insight-report-2022.pdf>

The North Sea Transition Authority Wells Insight Report 2022 estimates that approx. 100 wells are to be decommissioned in the next decade.

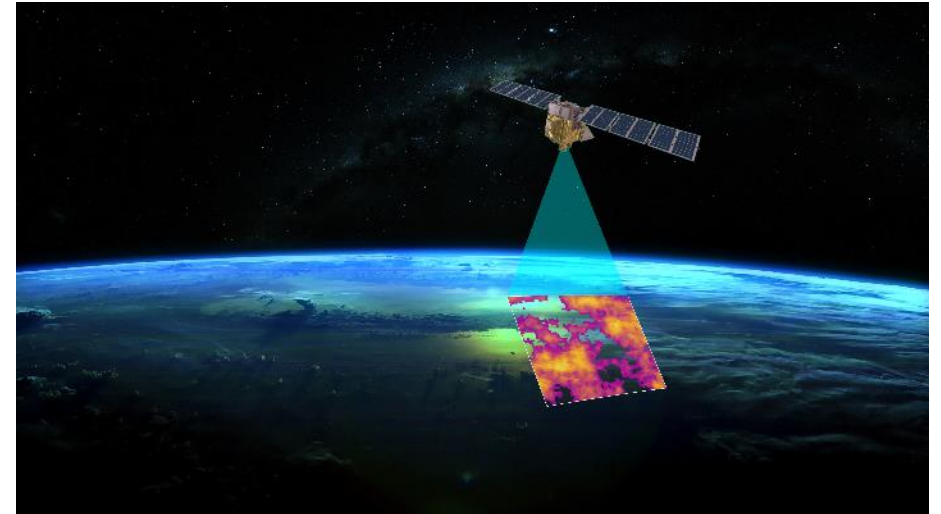
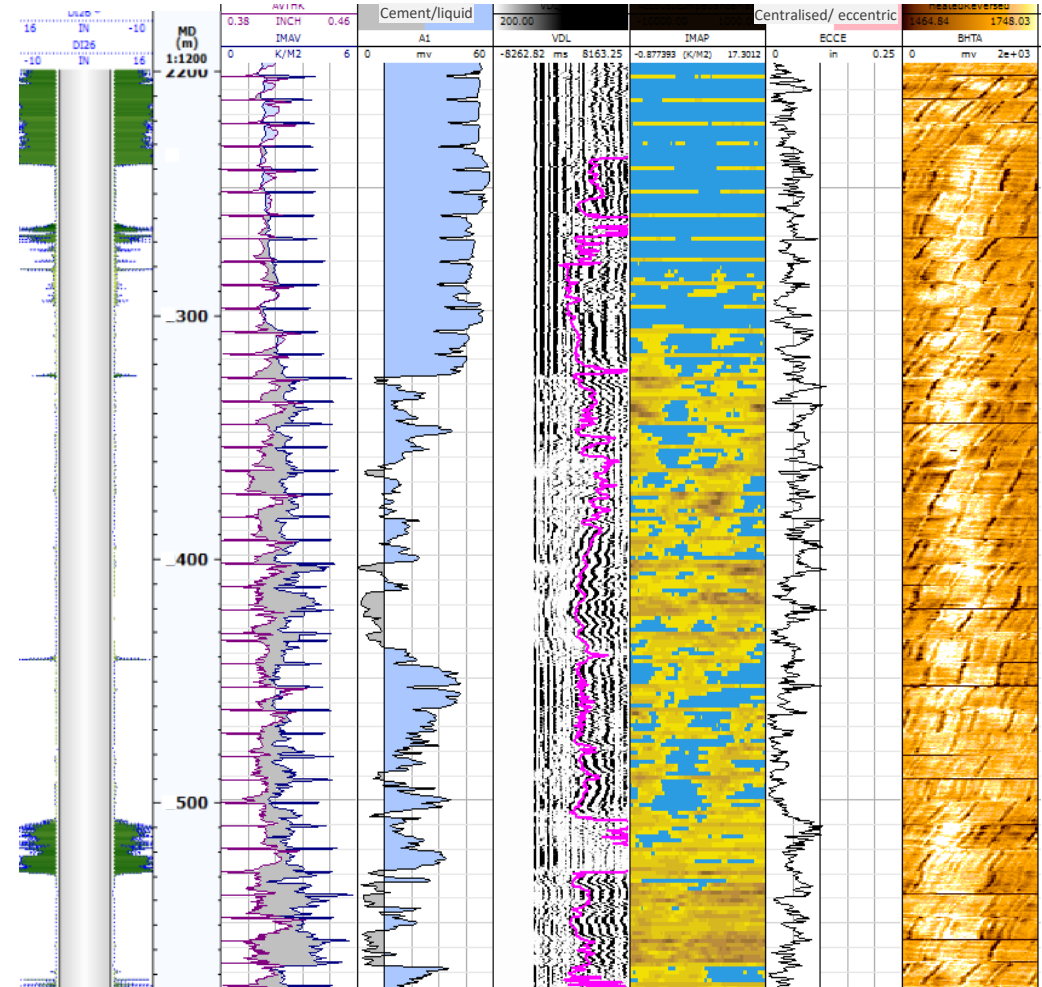


Photo: methanesat.org

“On March 4, 2024, MethaneSAT effectively detached from the SpaceX Falcon 9 rocket that carried the emissions-monitor into space.”


Agenda

- Introduction
- Standard, what standard?
- The art of cement bond evaluation
- How to achieve consistency
- Close out



Introduction

- Zonal isolation
- Reliable barrier
- Annular barrier verification
- Finding 'good cement' or its equivalent
- Documentation

Well Name	Zonal isolation standard	Circumferential cement sheath over flow zone
	✓	
Flow Zone 1		✗
Flow Zone 2	✗	
Flow Zone 3	✓	
Flow Zone 4	✗	
Flow Zone 5	✓	
Flow Zone 6	✓	✓

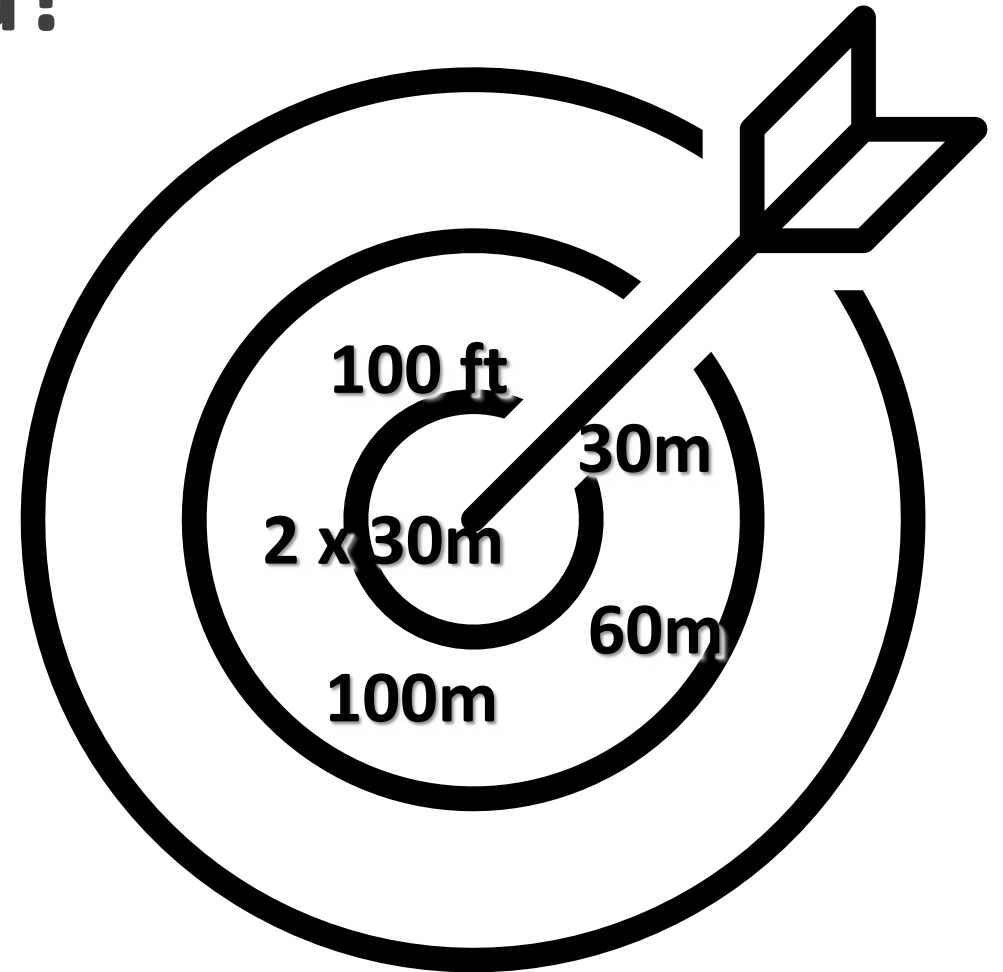
Standard, what standard?

Do you always know what standard you're working towards?



Standard, what standard?

- What is required for legal compliance?
- What is required for company internal compliance?
- How detailed is the standard on suitable verification?



Standard, what standard?

- The production casing review verifies that the production casing is [adequately cemented in accordance with Statewide Rule 13](#) to confine injected fluids to the proposed injection zone.
- The production casing must be cemented immediately above the injection/disposal interval with at least:
 - **600 feet** of cement based on cement volume calculations,
 - **250 feet** of cement verified by a temperature survey conducted at the time of cementing, or
 - 100 feet of cement verified by a cement bond log that shows the cement is well bonded to the pipe and formation (80% bond or higher) with no indication of channeling; or
- If the well was spudded prior to January 1, 2014, 500 feet of cement based on cement volume calculations.
- When evaluating top of cement calculations, UIC staff assumes Class A cement with no volume extenders (unless the application indicates otherwise) and a washout factor of 30% along the gulf coast and 20% inland.
- In the absence of cementing records, the casing will be presumed to be uncemented and the applicant will be required to file a cement bond log to demonstrate the adequacy of existing cement or perform a cement squeeze.
- Cement bond logs must contain a cement bond amplitude curve, an amplified cement bond curve, a transit/travel time curve, and a variable density/sonic waveform display.

Source: <https://www.rrc.texas.gov/oil-and-gas/applications-and-permits/injection-storage-permits/oil-and-gas-waste-disposal/injection-disposal-permit-procedures/technical-review/#cementin>

Good cement: Cement that has been verified as to quantity and quality as stated in Section 4 of these guidelines.

4.3 Annular Barrier

The annular permanent barrier should be verified by an appropriate combination of:

- Testing (e.g. perforate and test)
- Records from barrier material used (e.g. volumes pumped, returns during circulation, differential pressure, losses, centralisation etc).
- Sufficient annular isolation through the original cement job. If the quantity of annular cement (the estimate of TOC) is to be based on differential pressure or monitored volumes during the original cement job (rather than logs for instance), then a longer cement column may be required to allow for uncertainty. In this case, a 1,000-foot MD column may be considered adequate for the equivalent of two barriers or a combination barrier based on the assumption that sealing has occurred somewhere in the annular cement. This may be increased or decreased on a well-by-well basis depending on the confidence level of the original cementation (refer to Figure 14).
- Casing pressure history during the life cycle of the well
- Well-integrity reporting
- The leak-off test when the casing shoe was drilled out
- Field experience
- Pressure test
- Modelling of well lifecycle loading
- Modelling of cement job
- Logs (e.g. cement bond, temperature, sonic)
- Sampling of annular fluids

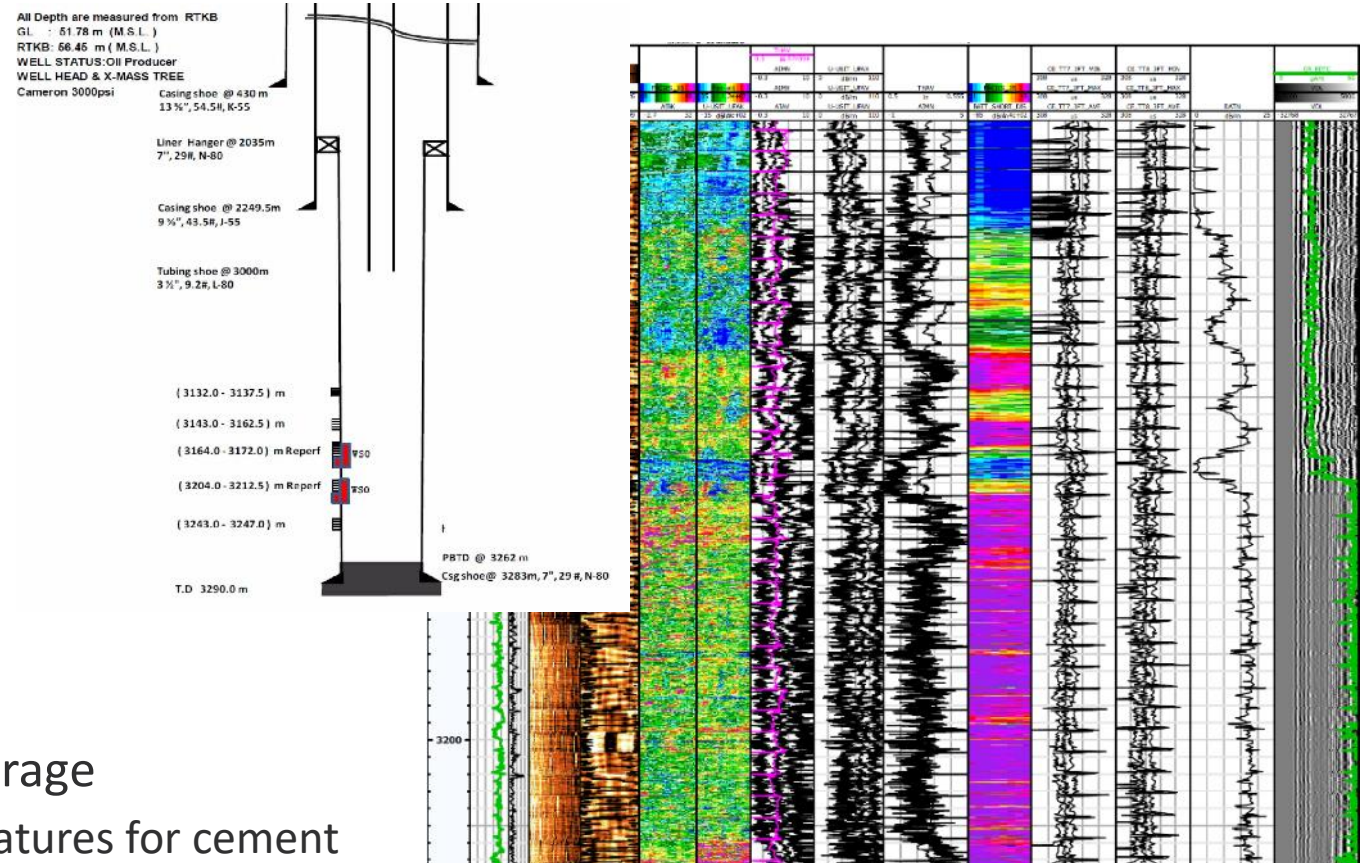
Note: Validity of historical data (logs, cementing records etc.) should be considered based on potential isolation degradation, or potential improved sealing properties, over time.

The art of cement bond evaluation



The art of cement bond evaluation

- Collect all the data
 - Cement job data
 - Log data
 - Well sketch & deviations
- QC the log
 - Tool eccentricity!
 - Casing condition
 - Thickness in line with casing thickness from completion record
 - Highlight anomalies
- Combine findings and infer cement coverage
 - Present key findings and highlight signatures for cement coverage as interpreted
 - Write a report!



How to achieve consistency

- Written procedures for
 - Logging purpose and requirements
 - Log QC steps
 - Integrative interpretation approach
 - Minimum requirements for interpreter competence
- Document interpretations
 - Including basis for cut offs
 - Assessment against set requirement
 - Name and affiliation of the interpreter
 - Date of interpretation

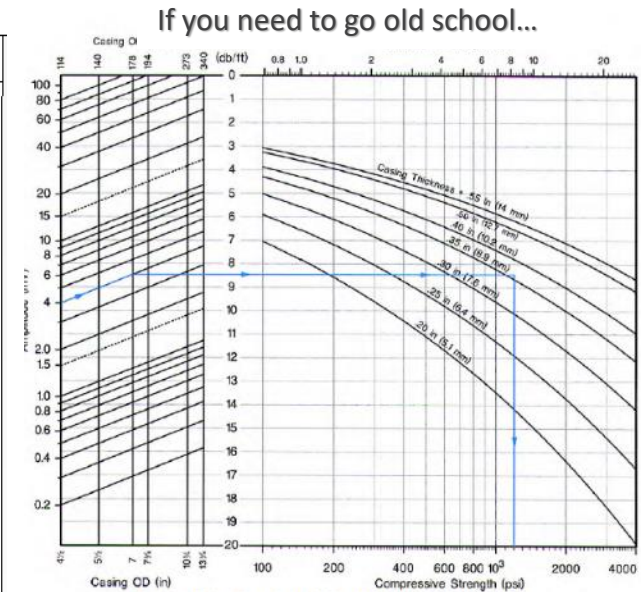
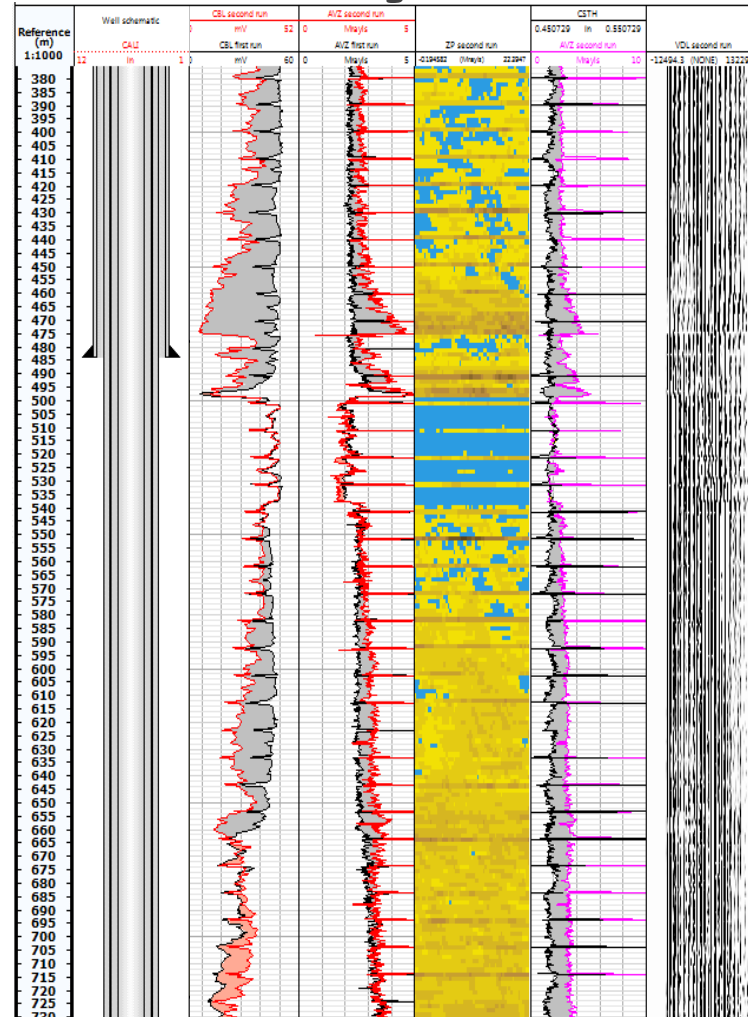
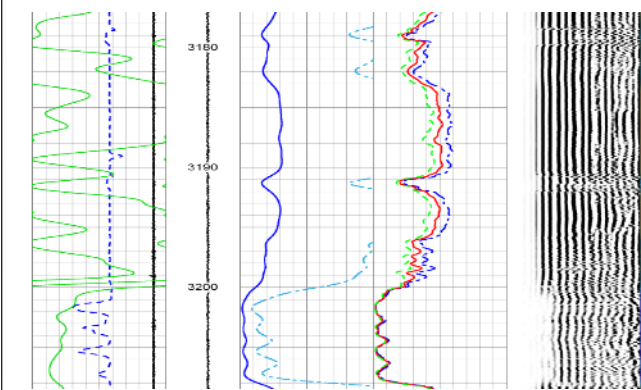


Figure 5.3—Typical CBL Interpretation Chart



Close out

- Which standard is relevant?
- Is Cement evaluation valid
- What measurements do I need?
- Have a written standard
- Have competent people do log interpretations
- Don't ignore other data!

- Ask a friend...

Cement Sheath Evaluation

Cementing Summary

9 5/8" Section Summary

Depth Interval [m]	Cement Stage	Slurry Density
0 - 1396	Lead	1.3 g/cc
1396 - 1945.2	Tail	1.9 g/cc

CBL log data

USIT
ZCMT: Lead 2.93 MRay
Tail 5.66 MRay

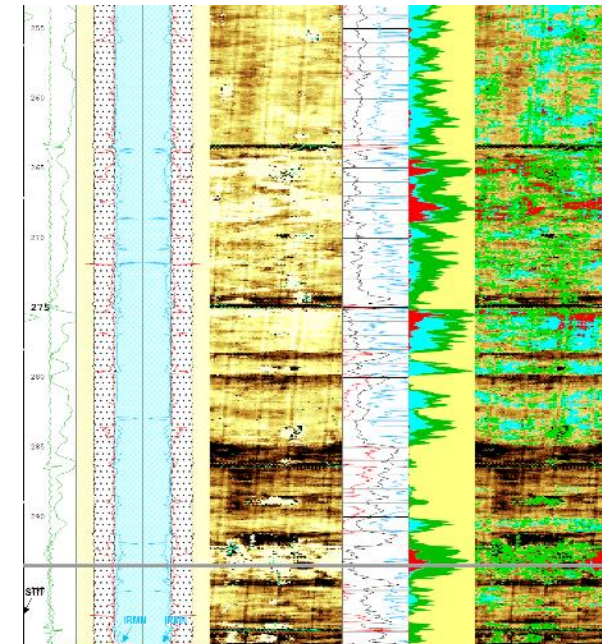
API TECHNICAL REPORT 10TR1
SECOND EDITION, SEPTEMBER 2008

7" Section Summary

Depth Interval [m]	Cement Stage	Slurry Density
TOC - 1785	Lead	1.4 g/cc
1785 - 2476	Tail	1.5 g/cc

CBL log data info:

USIT
ZCMT: Lead 3.2 MRay
Tail 4.9 MRay



Close out

- Planning
 - Integrate across disciplines – generously
 - Verify cement bond logging is suitable/valid method
 - Contracting & data acquisition programming
- Operations
 - Have a qualified logging witness
 - Ensure log data meets data requirements on safety, quality, efficiency and completeness
- Post job
 - Interpretation & write up including uncertainty considerations

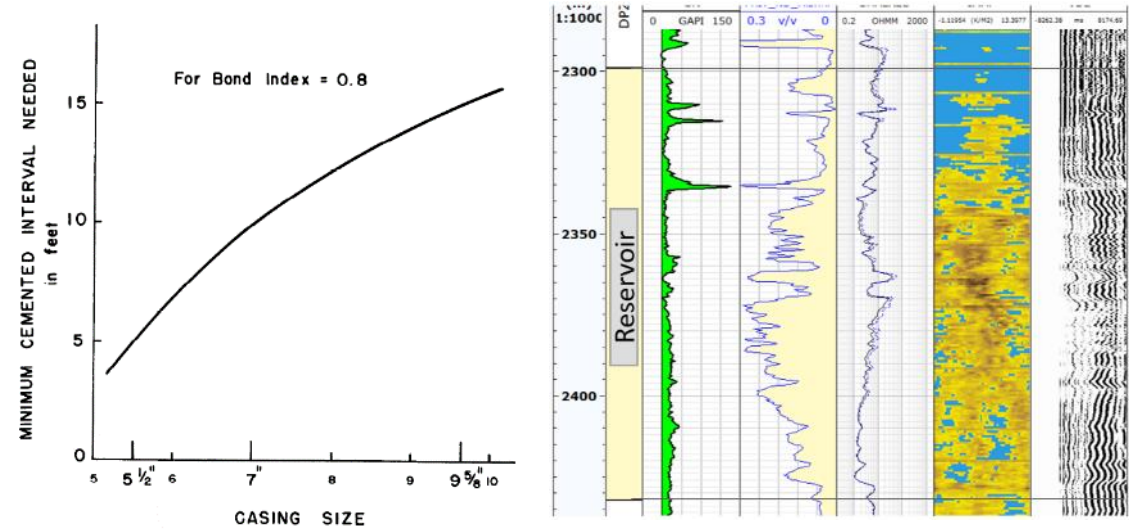
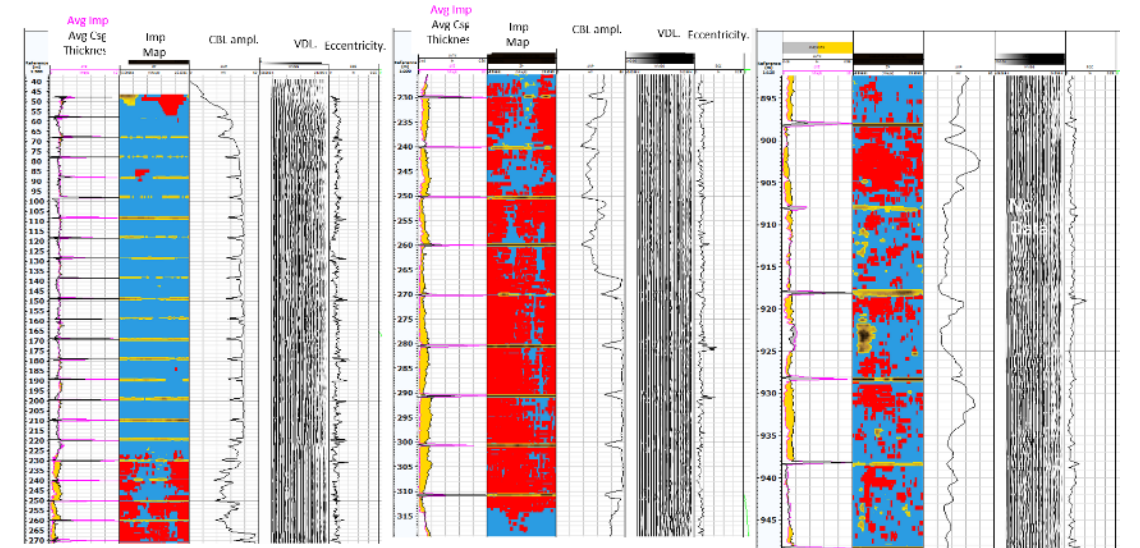


Fig. 4. Length of cemented interval required for zone isolation (for Bond Index = 0.8).





Thank you

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