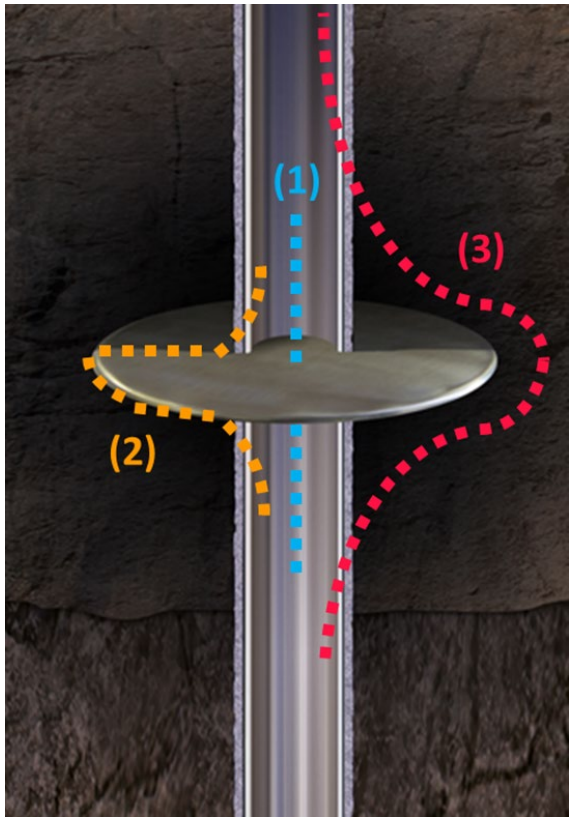
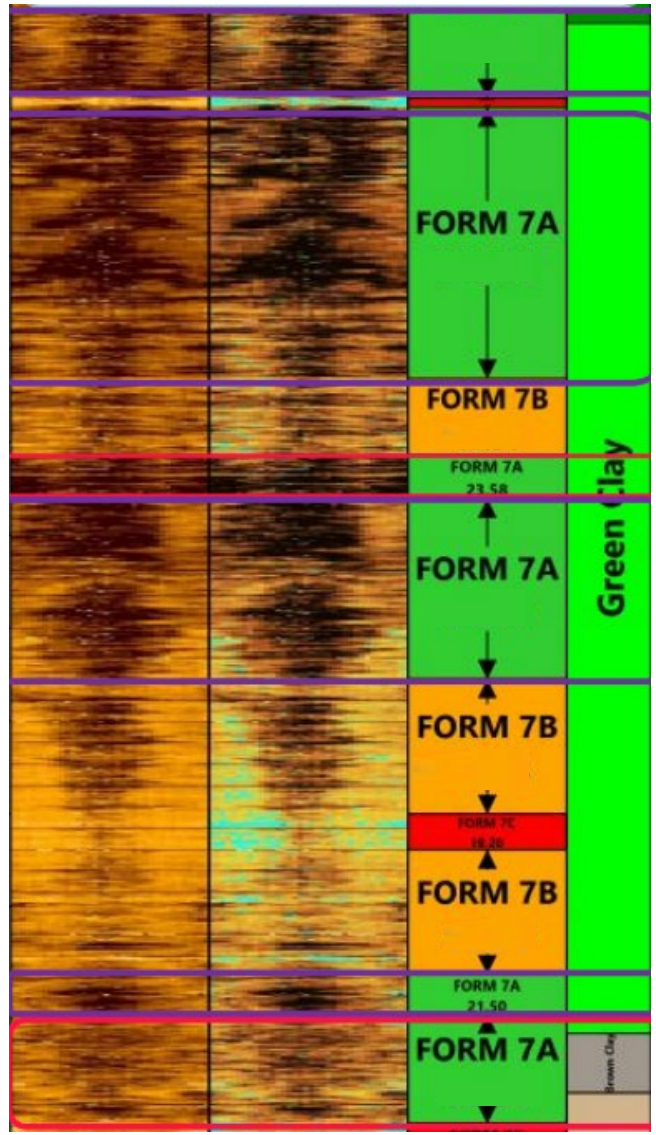
Short barrier plugs
- status on the barrier capacity project

Stein Åtland, Leading Advisor Well integrity P&A, Cessation and legacy wells
Equinor

WHY?

- P&A and Slot Recovery cost.
- Assessment of shorter fm creep / cmt intervals
- New P&A solutions
- Potential accumulation of shorter intervals
- Representative field conditions not available in lab.





- **What's the barrier capacity of a short length of annulus cement or formation creep?**

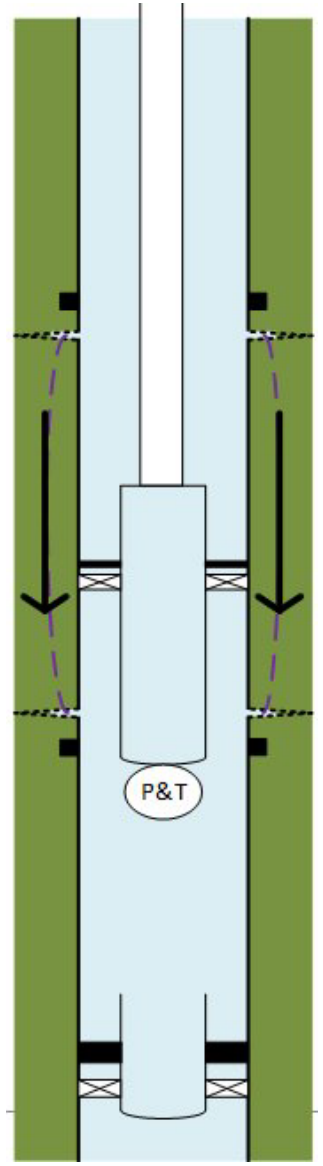
Test method – Overall principle

Conveyance: DP or Wireline

Sequence:
1. Bottom plug
2. Lower perforations/cut
3. Upper plug
4. Upper perforations/cut

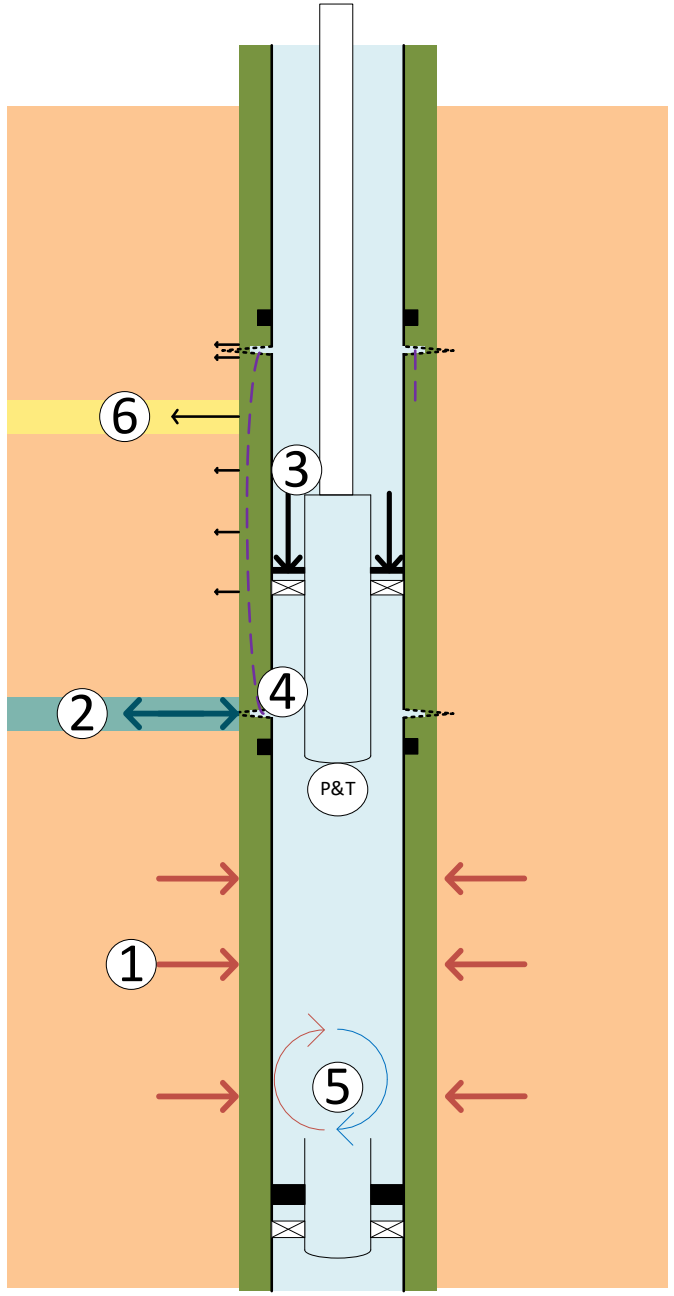
Differential pressure applied from above, monitoring below plug.

Success factor: Sensitivity



Factors affecting results

1. Heat transfer from formation to monitoring volume.
2. Formation hydraulic interaction.
3. Pressurizing plug – compression of monitoring volume.
4. Clay swelling / shrinking
5. Temperature convection within monitoring volume
6. Horizontal fluid loss along test interval

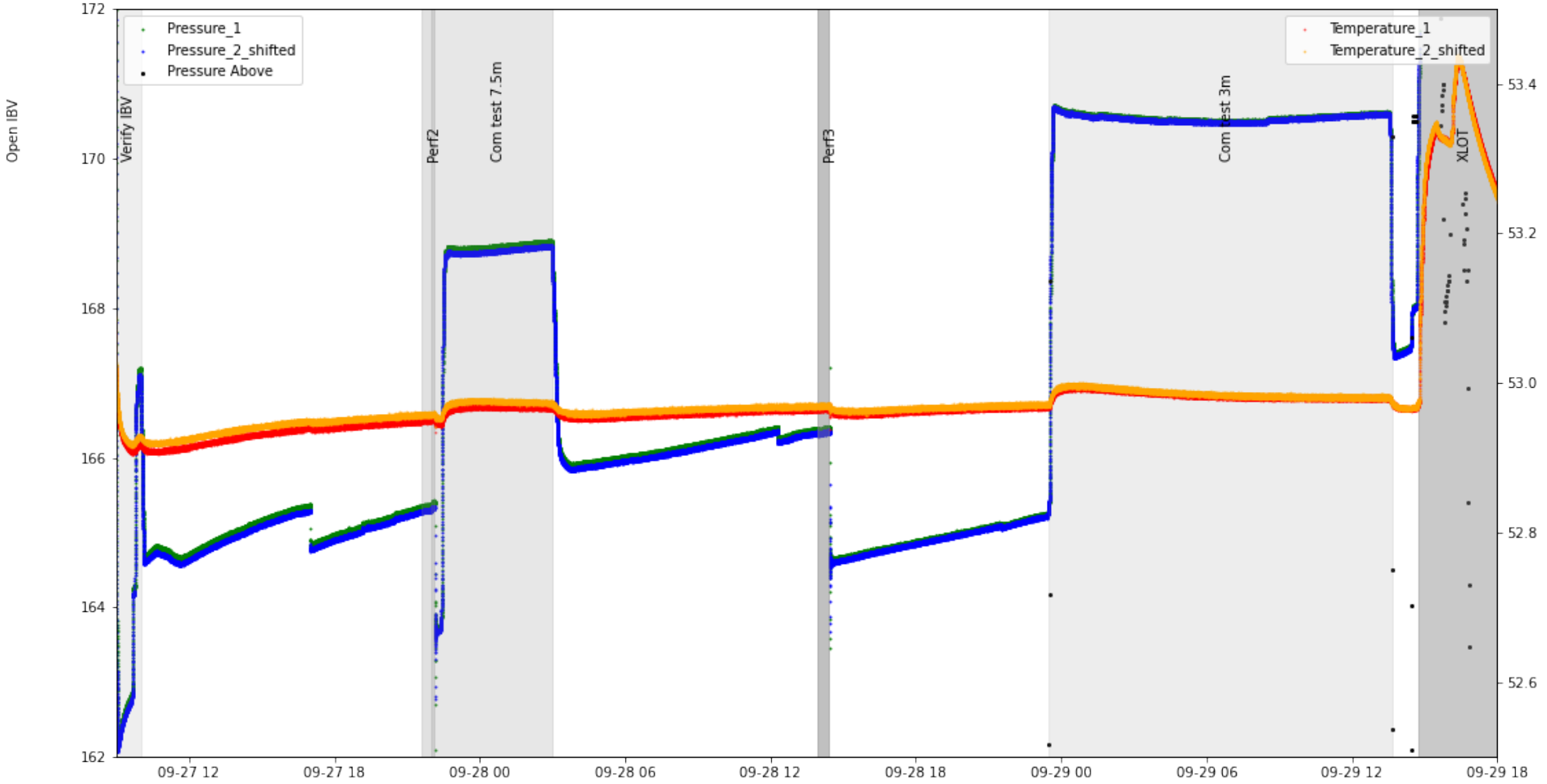


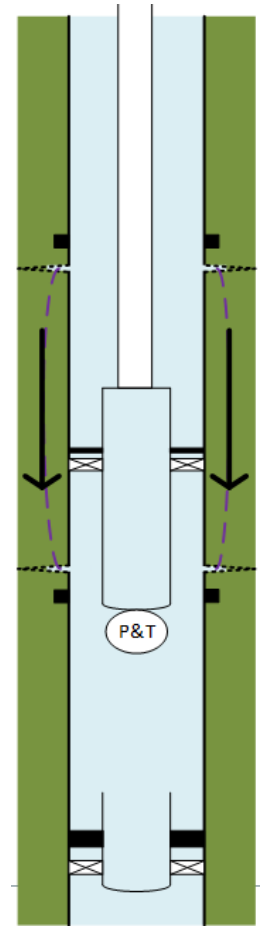
Test results

Field	Barrier length	Barrier material	Year
Veslefrikk	10 m	Formation creep	Q1 2021
Veslefrikk	5 m	Formation creep	Q1 2021
Oseberg	7 m	Formation creep	Q4 2021
Statfjord	3 m	Cement	Q3 2022
Field A	4,5 m	Formation creep – Equipment failure	Q3 2022
Field B	3,5 m	Cement – Equipment failure	Q4 2023
Field C	3,5	Cement – Leakage observed	Q1 2024
Field D	5 & 10 m	Cement – heterogeneous	Q3 2024
Field E	4 m	Formation creep	Q3 2024
Field F	~5 m	Formation creep	Planned Q4 2024

Cement test # 1 - 3m test

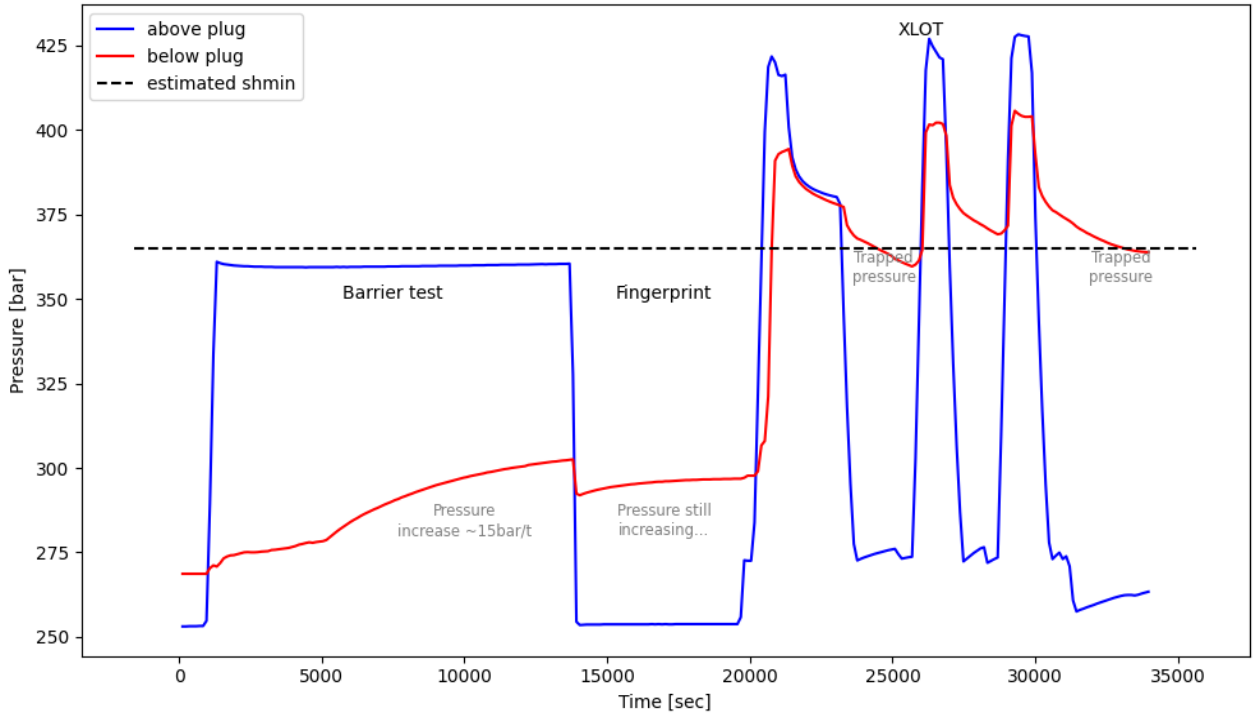
From closing IBV to XLOT

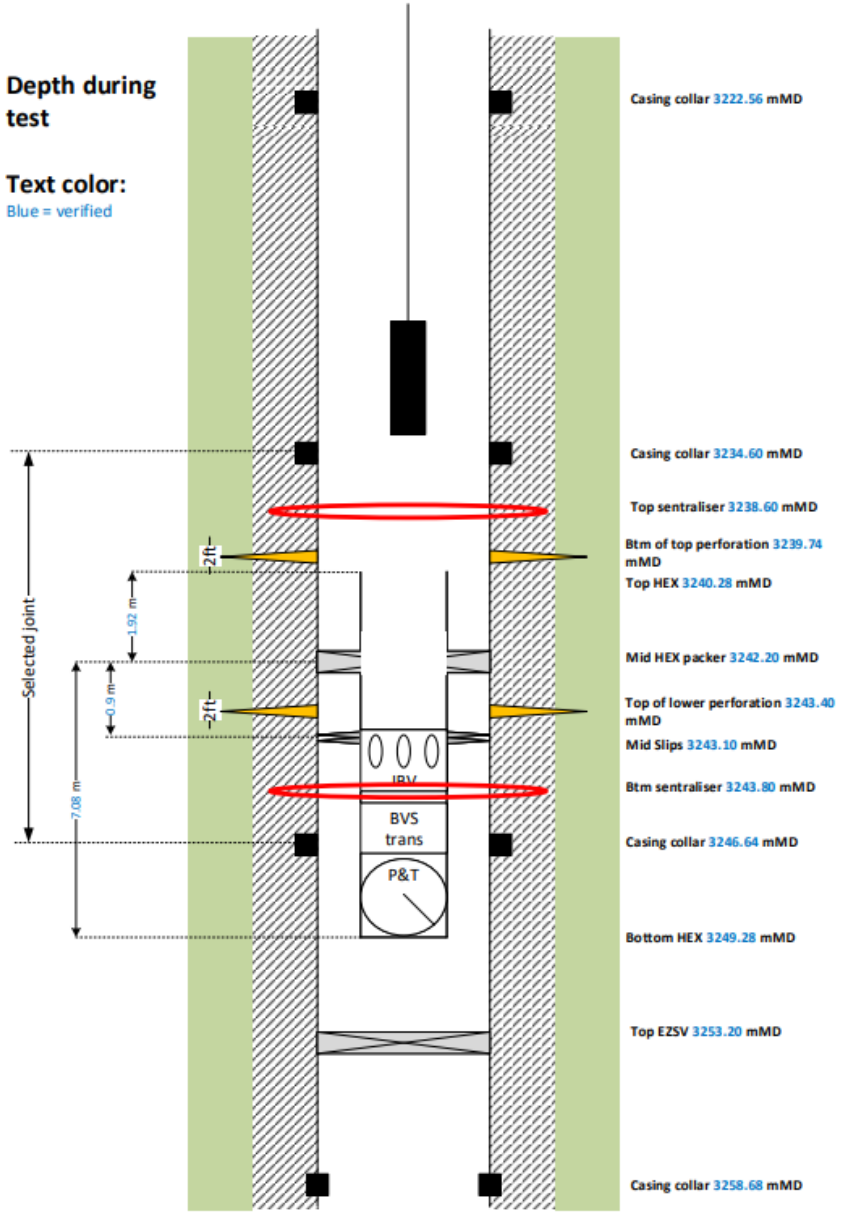




Cement test # 2 – ~3.7 m

- Interval selected from preliminary interpretation of the cement bond log.
- Installation process on wireline.
- A significant leak was noticed immediately during the communication test and later an accelerated leak-rate was observed.

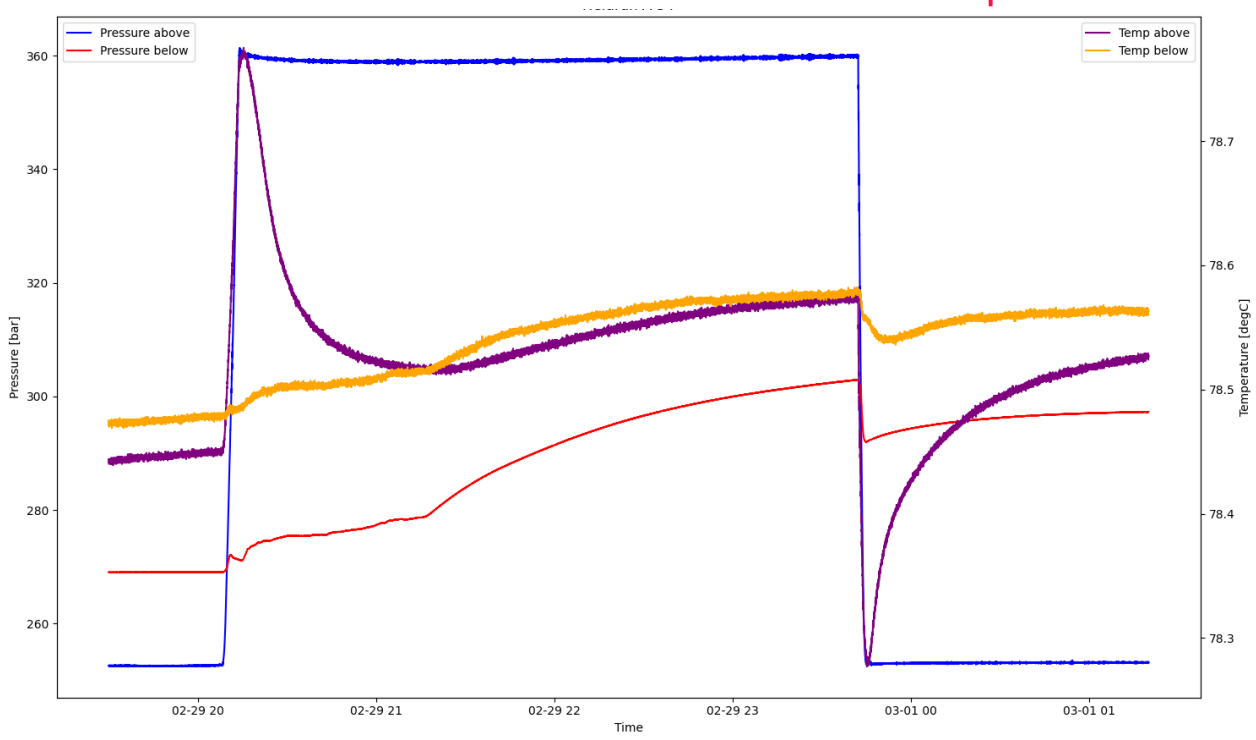


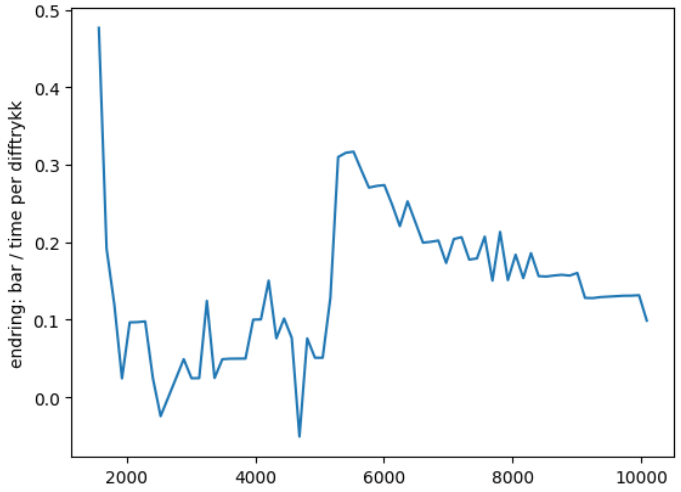


Cement test # 2 – ~3.7 m

Overview plot with pressure and temperature

- The pressure in the monitoring volume (**red**) was increasing from the beginning of the test with ~7.5 bar/hr but is also showing a distinct increasing trend after 1hr (at 21:15 with 14 bar increase the following hour).
- Temperature increase in the monitoring volume (orange) during the test is ~0.15 degC and some can be attributed to the pressure increase*
- The pressure above the plug (blue) was stable during the test and no pump strokes was required to maintain pressure.
- The temperature above the plug is shown in purple



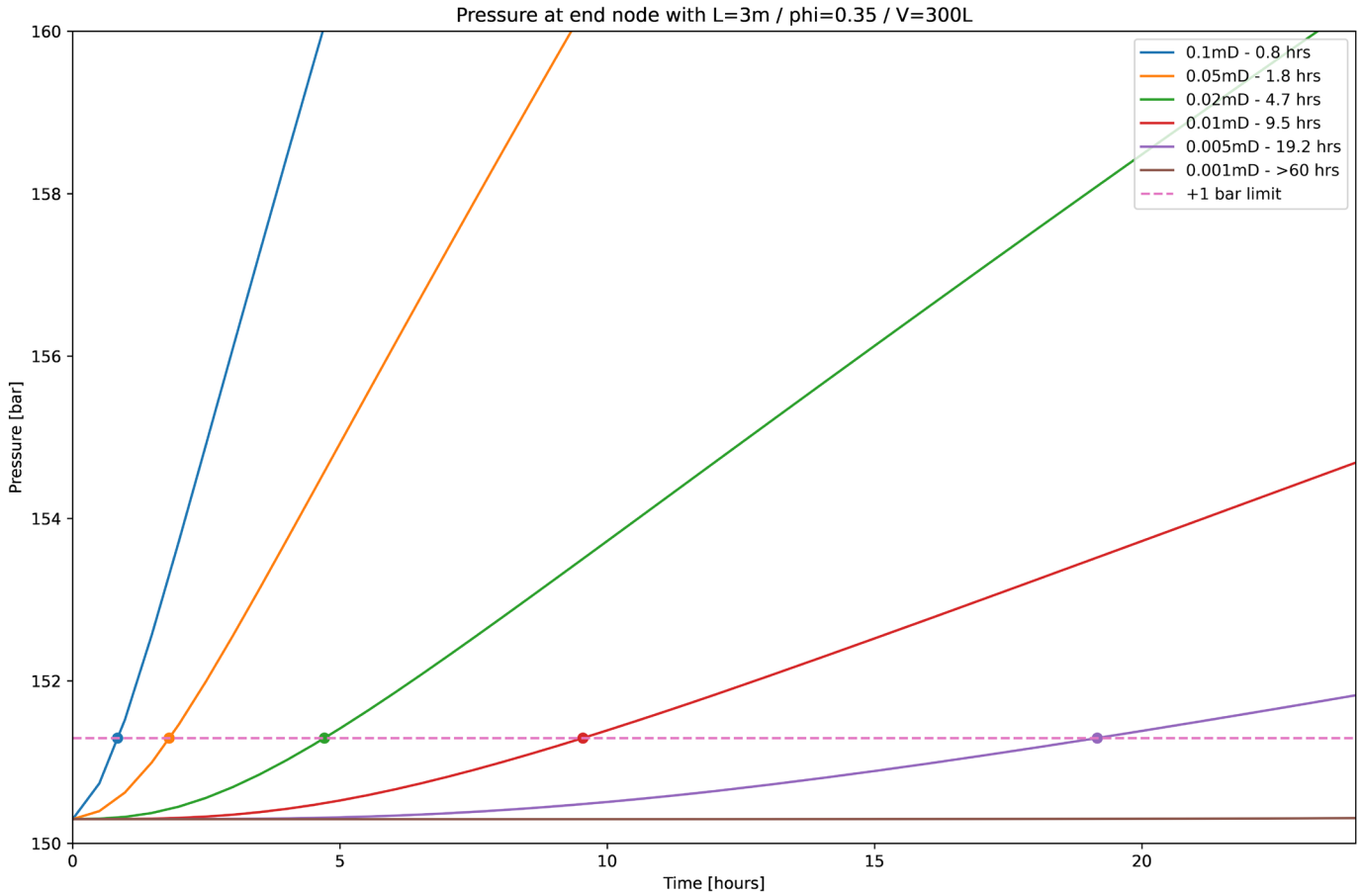


Where are we now!

- **Shortening the test length** is still favorable for data collection.
- Formation interaction is larger than anticipated.
- Simulation models assist in showing what cases are feasible to detect.

- **In order to improve as an industry – more data collection and sharing of learning is needed.**

- **We encourage other operators to invest in this type of testing**



QUESTIONS?