Cases – section 1

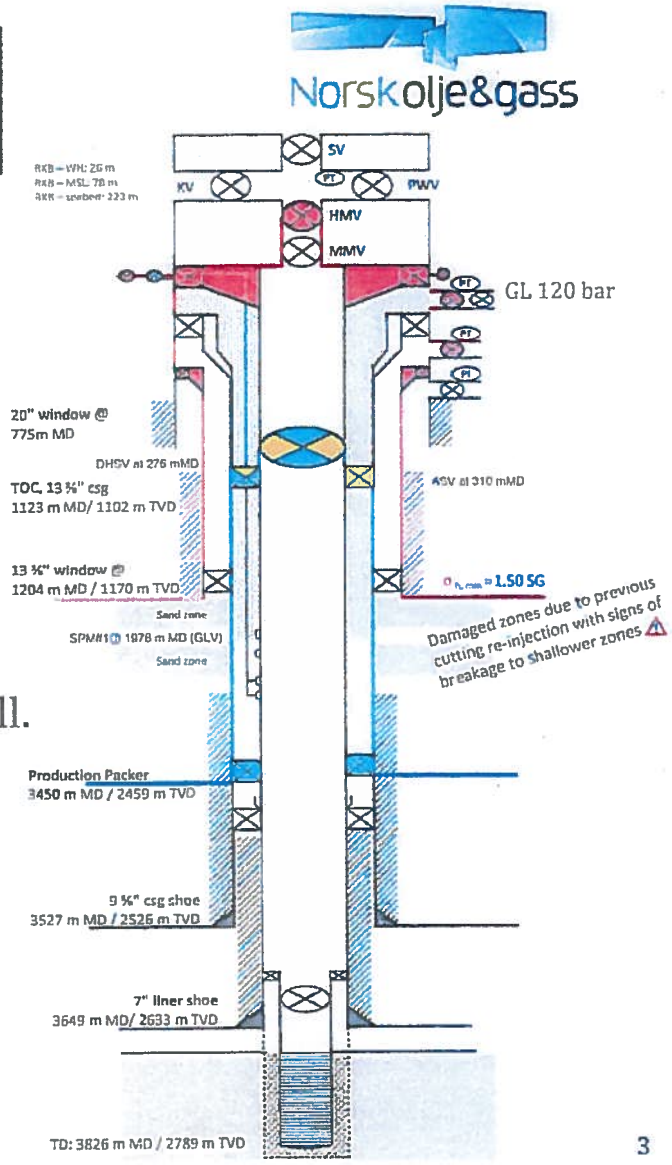
Category	Principle
Red	One barrier failure and the other is degraded/not verified, or leak to surface
Orange	One barrier failure and the other is intact, or a single failure may lead to leak to surface
Yellow	One barrier degraded, the other is intact
Green	Healthy well - no or minor issue

Case 1

CRI = Cuttings Re-Injection
FIT = Formation Integrity Test
LCM = Lost Circulation Material
σ_{IImin} = Minimum Horisontal Stress

Well Details

- Oil producer with artificial gas lift.
- Drawing shows barriers against gas lift.
- Previous oil producer with CRI in B-annulus.
  - Signs of breakage to shallower layers.
- Good FIT at 13 ⅜" window after squeezing LCM.
- Packer installed as annulus barrier due to previous observed pressure build-up in B-annulus before re-completion to gas-lift well.



Discuss

- What is the barrier status code when well is on gas lift?
- Do code change if gas lift is stopped?
- Do code change if lift pressure is reduced to i.e. < pressure in sand zone.

Case 2

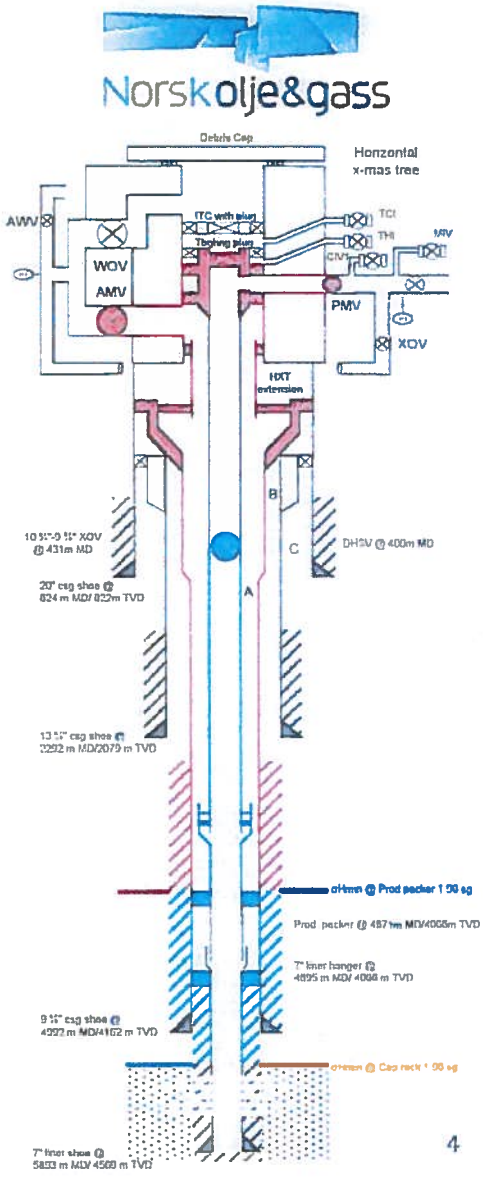
SCM = Subsea Control Module

Well Details

- Subsea gas injector
- All barriers initially verified OK
- Due to SCM failure well monitoring is lost (i.e. can not read pressure or see status of valves).
- Still possible to open/close valves.

Discuss

- What is the barrier status code when:
  - Injecting after SCM failure
  - Shut in after SCM failure
- Is it OK to continue injecting;
  - One day?
  - One week? (longer?)
- Do barrier status code change after well has been shut in for months without repair of SCM?
- What if monitoring is OK but pressure reading in A-annulus is lost? Or in XT cross? OK to continue?



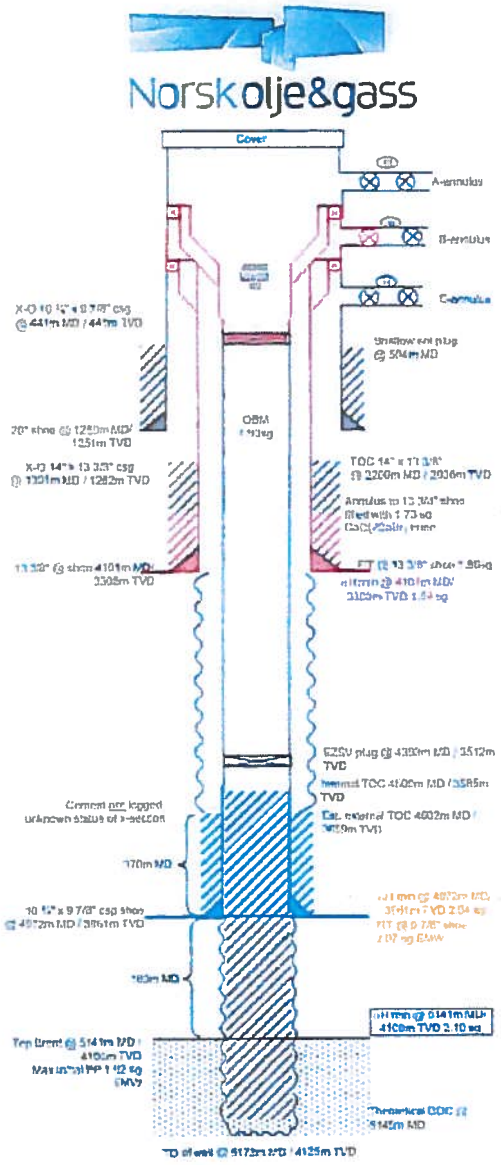
Case 3

Well Details

- Planned as gas/condensate producer.
- Drilled into reservoir got severe losses and decided to temporarily abandon (10 years ago).
- Cement only verified as one barrier.
- Shallow plug set and tested.
- Hole cover is not a pressure containing element.
- B- & C- annulus are monitored.

Discuss

- What is the barrier status code?
- What are the risks if left as-is for more years?



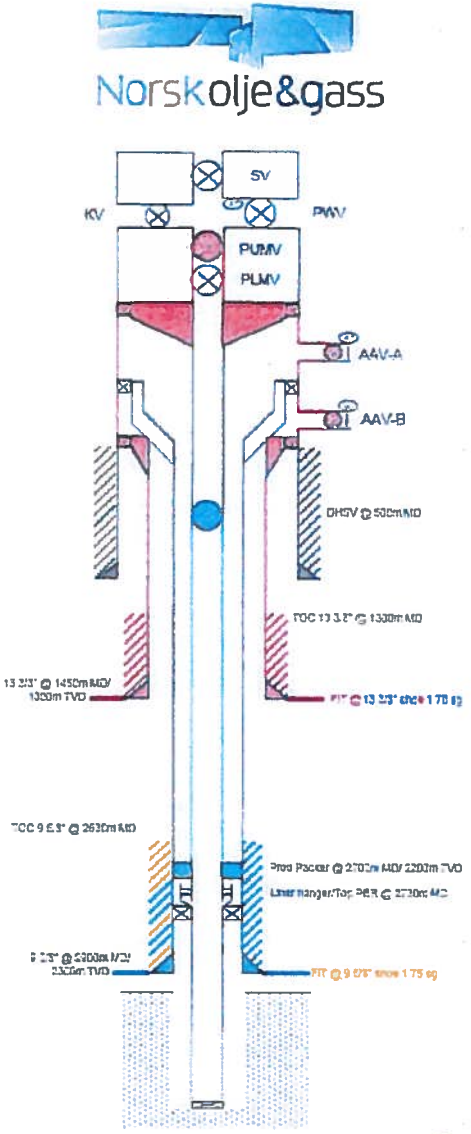
Case 1 – Low pressure water injector

Well Details

- Water injector
- Monitoring on A & B annulus.
- Pressure support for gas lifted wells producing from the same reservoir
- ~80 - 100 bar injection pressure
- After halt in injection pressure drops instantly 20-30 bars, before slowly dissipating with a drop of a couple of bars per day.

→ Well goes to vacuum after a period of ~1-2 months

→ Vacuum tendency has been verified from previous shut-in over a period of 4 tears

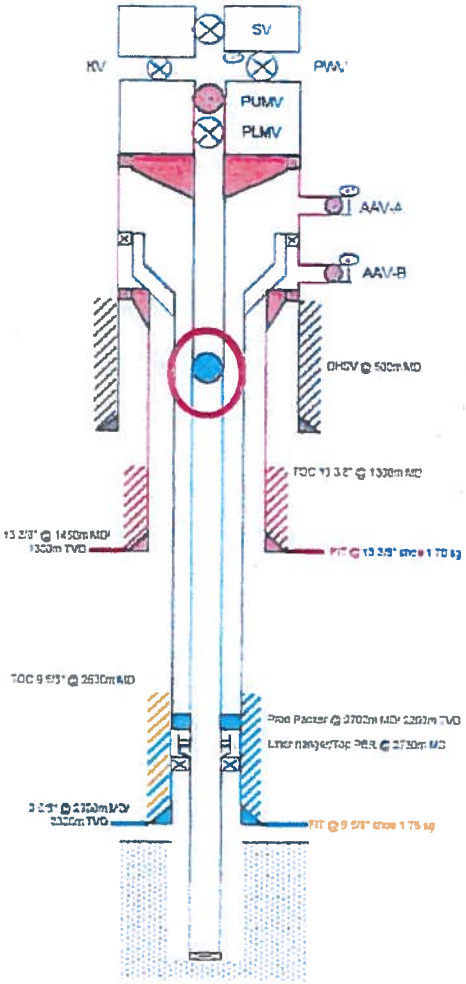


Well issue

- During regular PM-testing of valves, the DHSV failed; full function failure; meaning valve did not close
- SIWHP at test was 75 bars
- No short term actions had any effect on valve
- The XT valves were tested and deemed ok

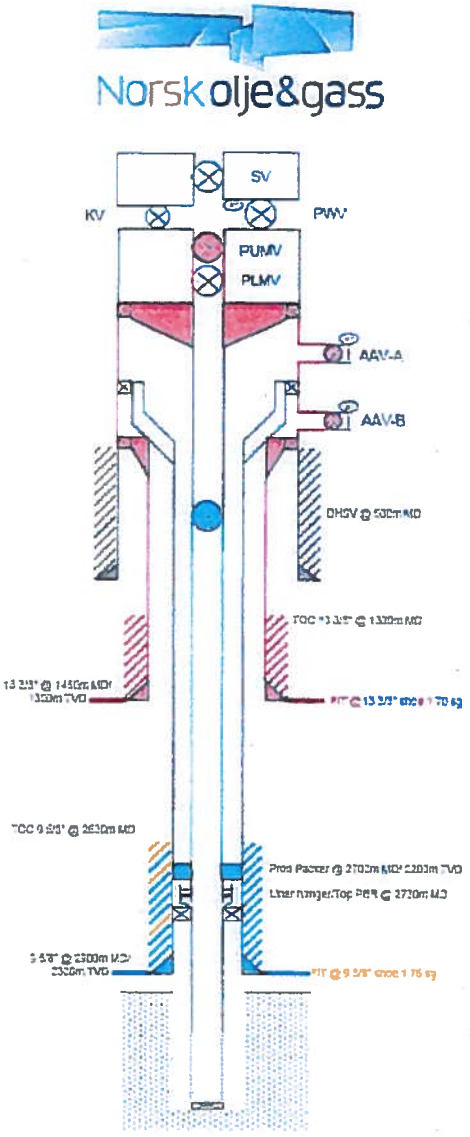
→ Well was shut in pending solution

→ Well assessed to not be of any more need for the future of the field



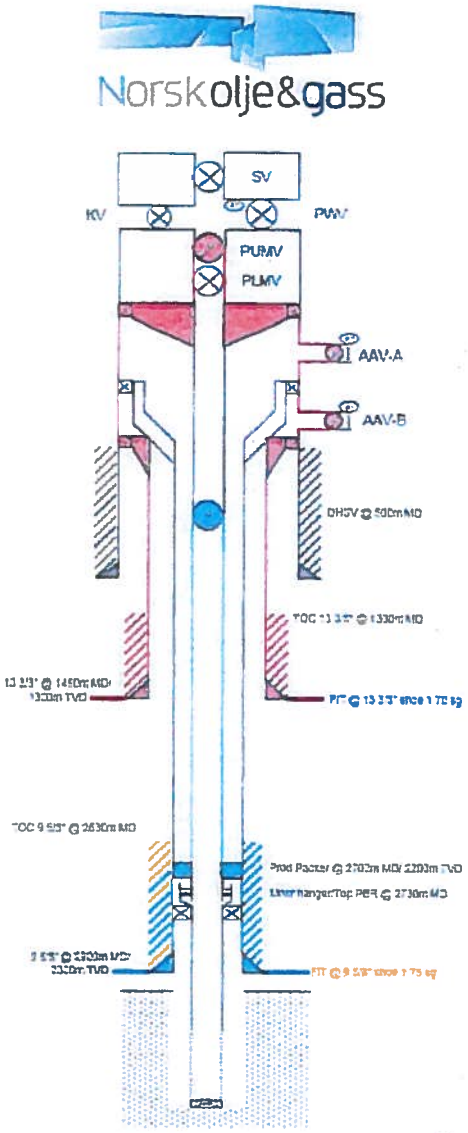
Discuss

- What is the Barrier status code at time of incident?
- Discuss the as-is risk of the DHSV-failure in this well after shut in?
- Any proposed mitigating actions for resolving this situation? Why the proposed measures?
- Will the barrier status remain the same for the foreseeable future? What will lead to a change in status (if any)
- Possibility in evaluating change in barrier philosophy?



What if....

- Will reservoir characteristics result in different evaluation of the status code?
- Reservoir characteristics was unknown (no period of vacuum verification); would change in code/barrier philosophy still be deemed an option? Why/why not?



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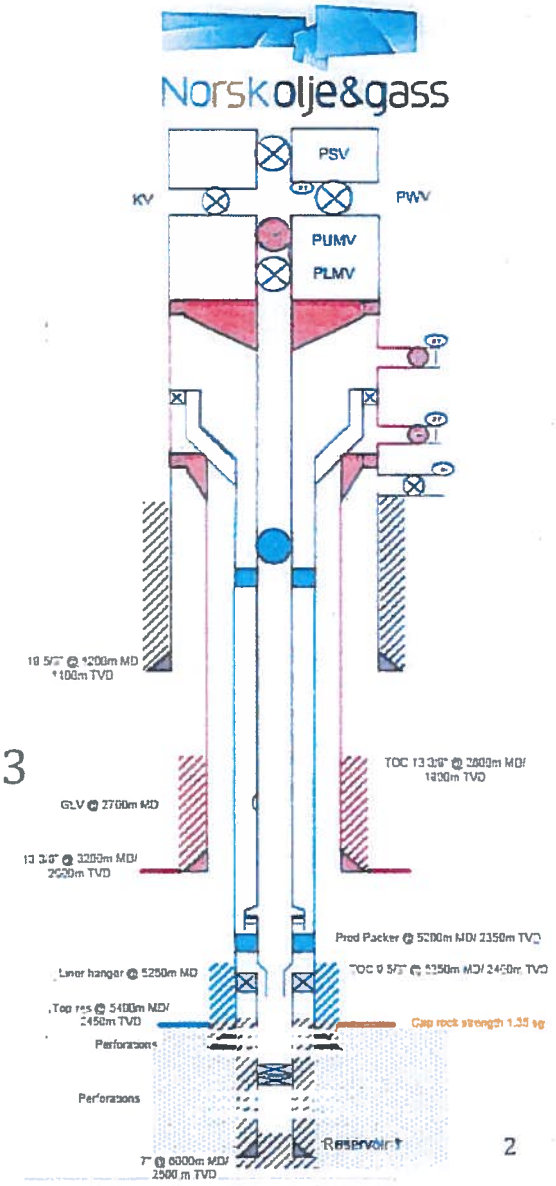
Case 2 – Non-qualified barrier

Well Details

- Oil producer on Gas lift.
- On/off production for 15 years.
- Non flowing if gas lift is shut off; but gas does migrate from reservoir into tubing if shut in.
- Low reservoir pressure.
- Injection in A annulus.
- B & C annulus monitoring. No issues/pressure anomalities detected during lifetime of well.
- Non-gas tight threads in intermediate casing (13 3/8" casing)

→ Barrier status code as is?



Well issue

- During re-evaluation of barrier drawing and geological model, a shallow zone deemed as reservoir has not previously been represented on the barrier drawing.
  - Top of reservoir located at 4000mMD.
- The reservoir characteristics of the shallow zone are poor. Pressure in zone slightly above the hydrostatic gradient, but presence of gas cannot be ruled out.
- Assumed to have little or no flow-potential by Production technology.

When accounting for this new information, discuss

→ What is the resulting status code of well?

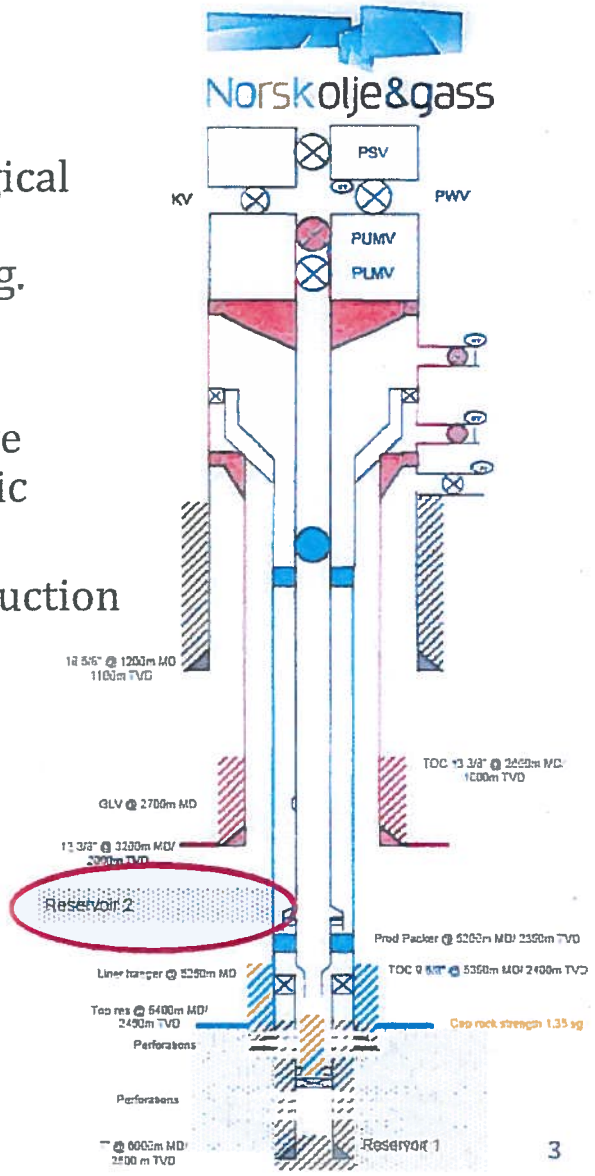
→ Shut in or continue operation?

→ Further actions to be performed?

→ Mitigating actions?

→ Risk of well?

→ Other comments?



What if...

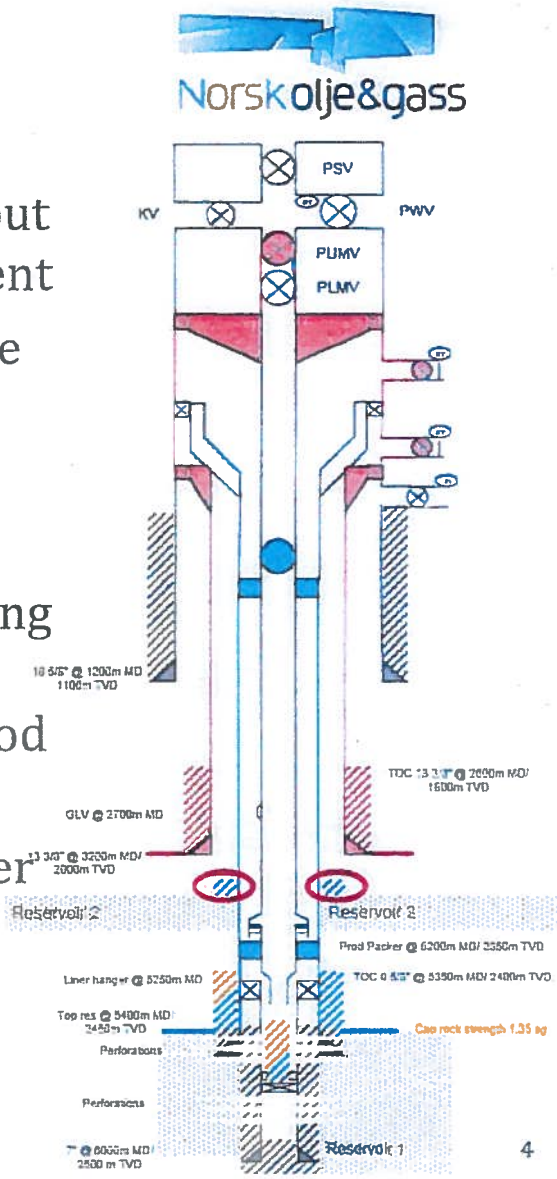
- Logs were present showing cement in places but patchy and only in total 10 m continuous cement

→ Would it lead to a different barrier status code evaluation?

→ Would the change lead to a change in risk picture?

→ Would distance between top of reservoir casing shoe have any impact on risk/status setting code? (shorter flow potential HC/ less likelihood of isolating creeping formations).

→ Would reservoir characteristics change barrier status code evaluation? High potential for gas/good flow capabilities?



Well prepared for permanent abandonement

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- Logs taken after pulling tubing shows a long bonded interval above shallow reservoir.

→ Barrier status code of current situation?

→ What if bonded interval was creeping formation that hadn't been qualified according to requirements in NORSOK D-010 but still showed a cumulative high bonded interval of 400m+?

→ What if logged interval above shallow zone was only 20m, what would be the resulting barrier status code in this case?