Casing and Tubing Design for CCS Wells: **a Review of Critical Scenarios**

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Special about CCS well design

CO_2 density & phase changes

Temperature shocks in transient operations

Early to late-life reservoir pressure changes

CCS specific load cases developed

5 load cases for production casing

- Covers CCS worst case scenarios

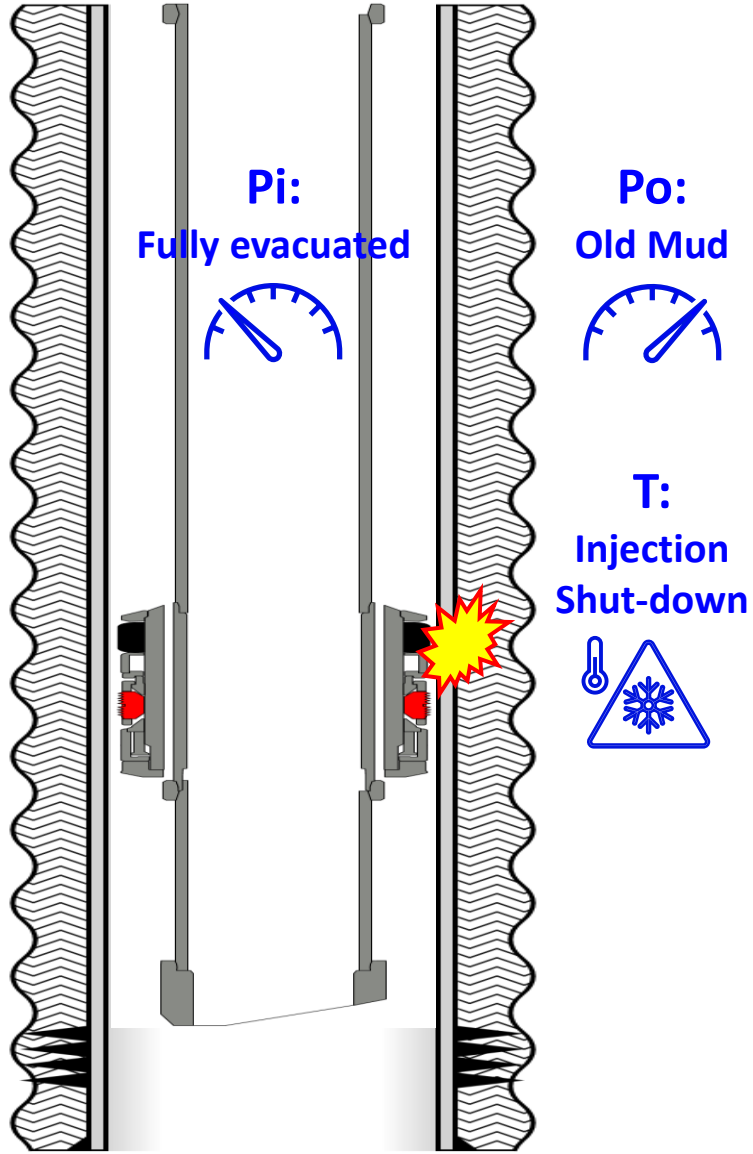
12 load cases for completion

- Covers transient operation load cases for both early & late-life scenarios

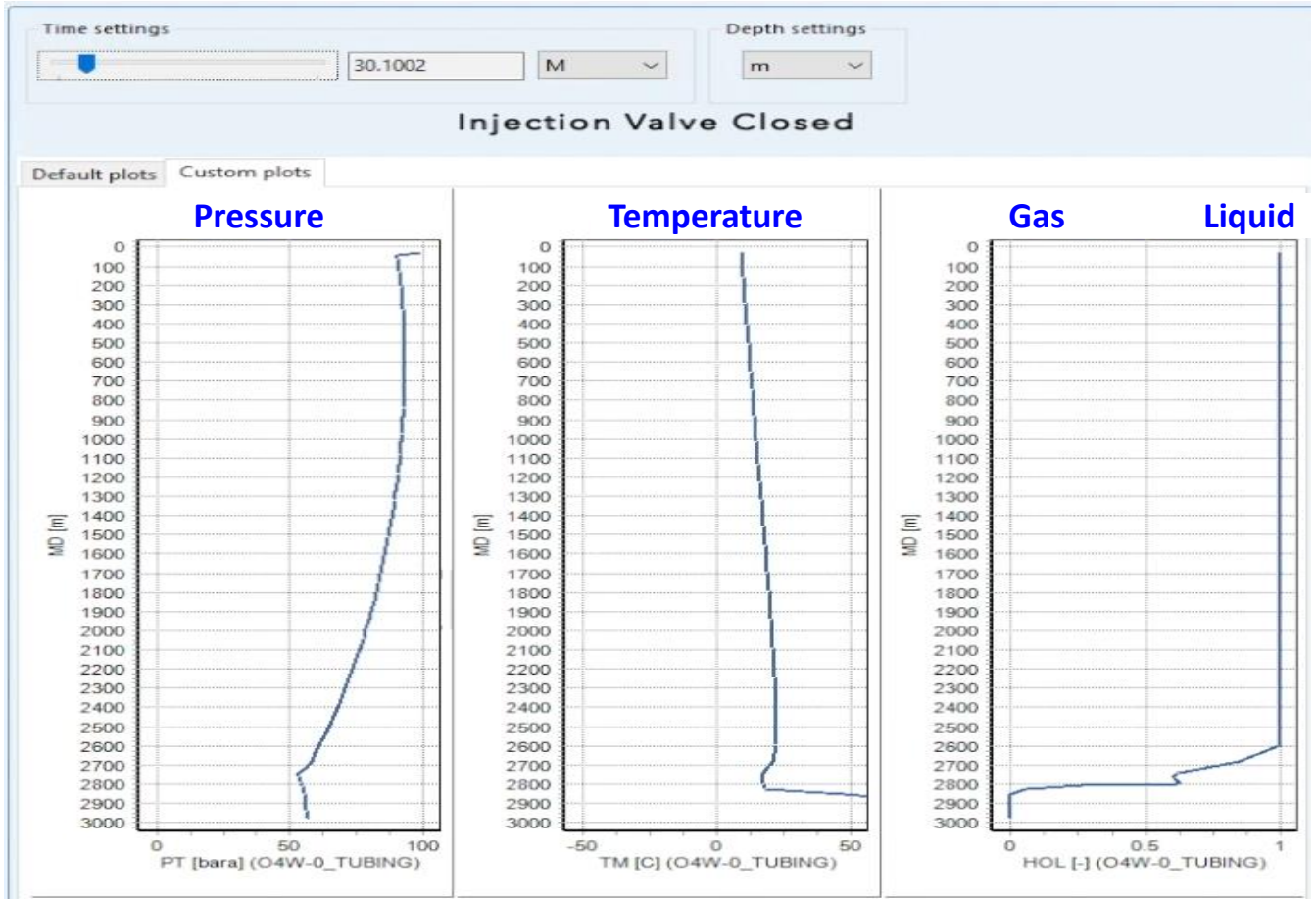
Example Load case 1 - Casing: Packer leak full evacuation

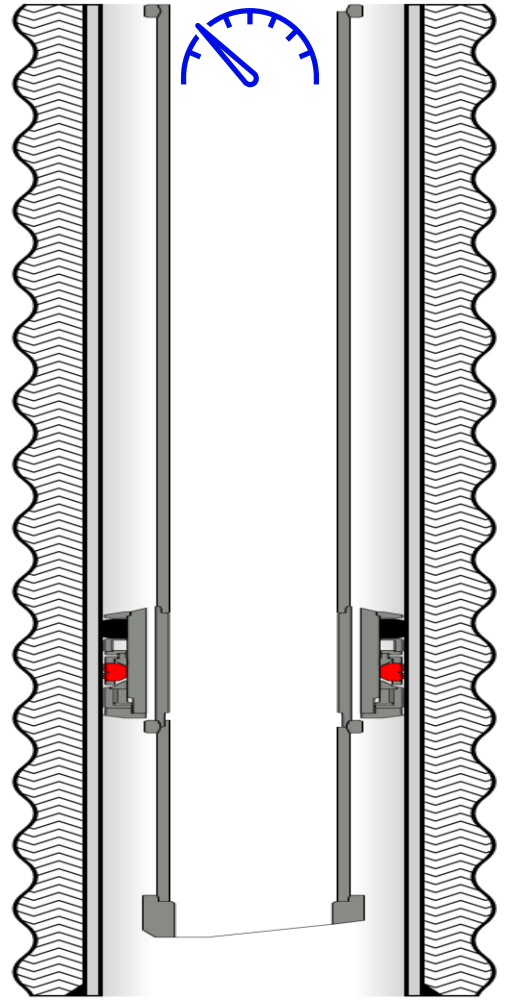
Assumptions: Completion packer failure and full evacuation in casing

- Internal pressure: Fully evacuated
- External pressure: Old mud
- Temperature: Injection Shut-down



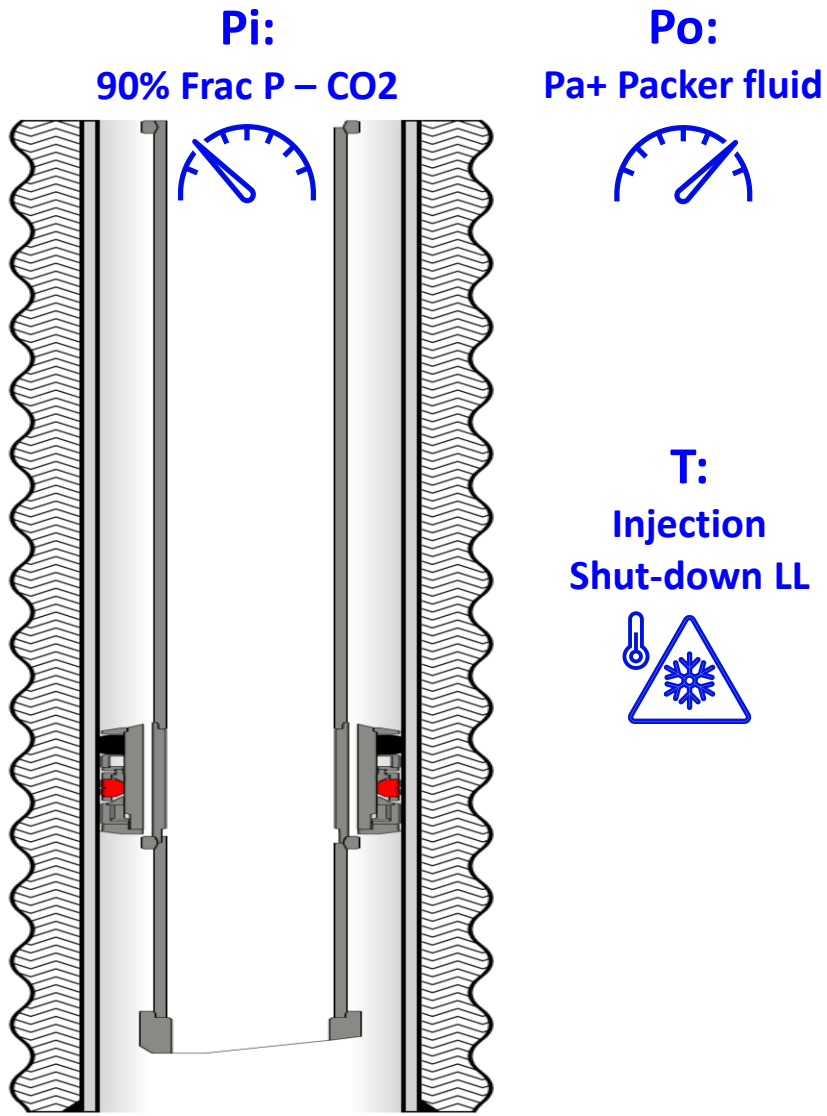
Example Load case 2 - Completion: Injection Shut-down (Early life)





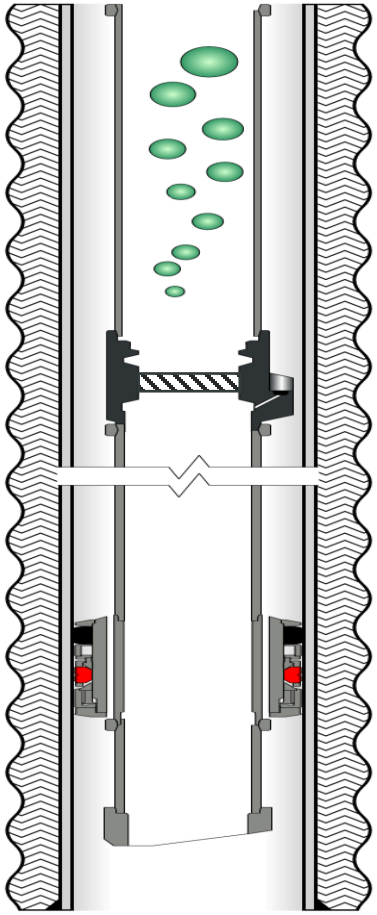
Example Load case 3 - Completion: Injection Shut-down (Late life)

- Internal pressure: 90% of fracture pressure – CO2 (liquid)
- External pressure: Annulus pressure (higher) + Packer fluid
- Temperature: Injection Shut-down @ late life

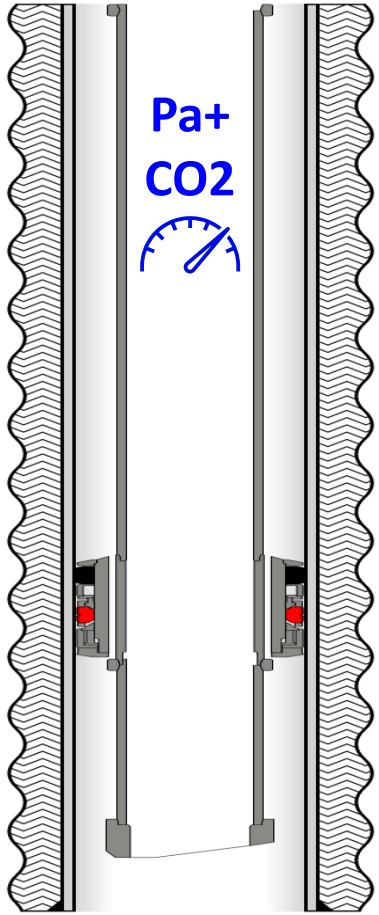


Other load cases

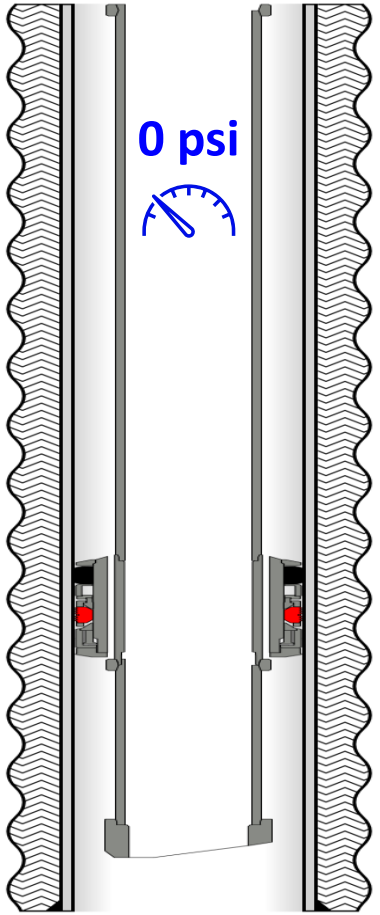
Safety Valve closure



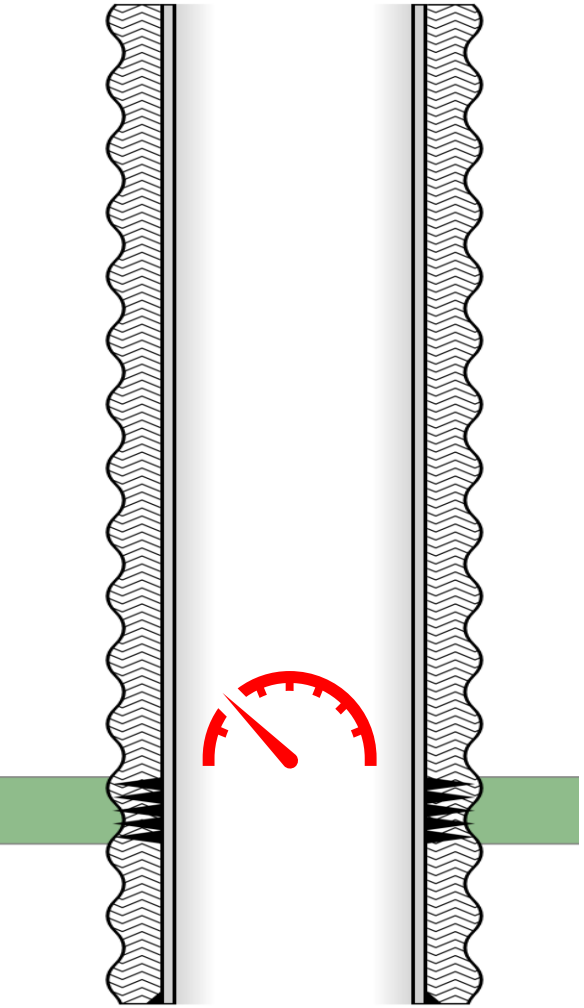
Injection Start-up



Fully Evacuation

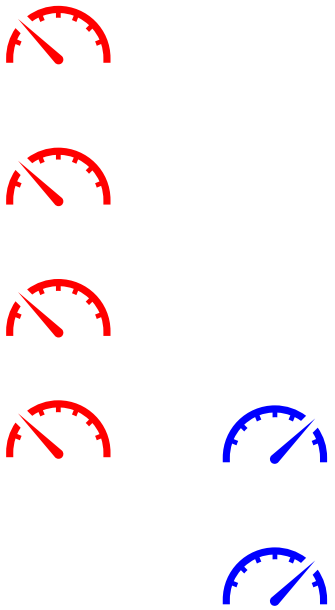


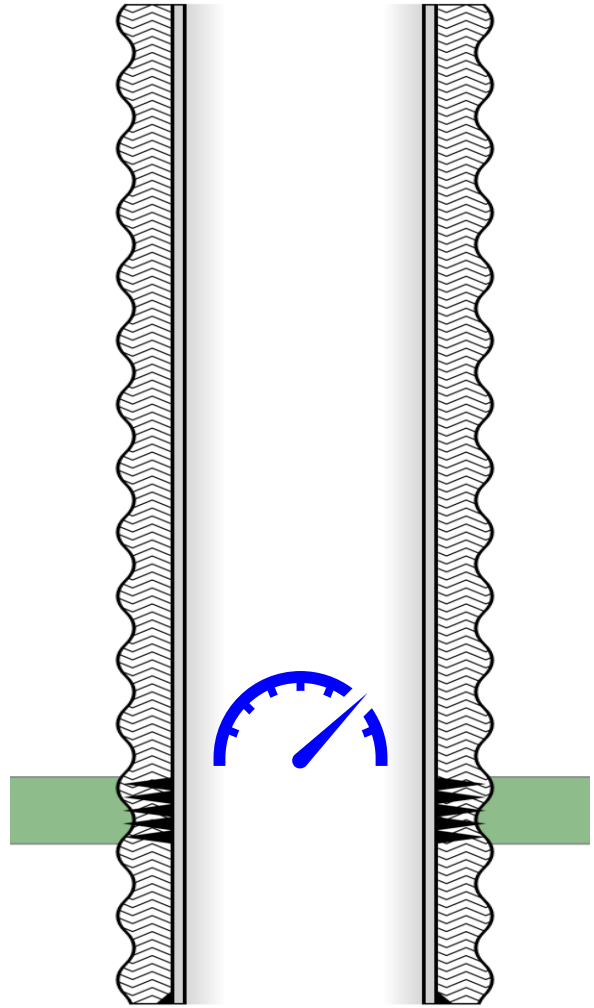
Cooling effects vs Reservoir pressures



Scenarios:

- Steady-State Injection
- Injection Shut-down
- Injection Re-start
- Blowout
- SSV Closure





Summary

Mostly **collapse cases for completion** and **burst cases for casing** due to recommended annulus pressure.

Full evacuation at late life places the greatest challenge on completion.
Packer leak full evacuation gives the worst-case scenario on casing.

Dynamic modelling is always recommended but general assumptions can be made for load cases.

Low temperature in some scenarios brings new **qualification challenges on downhole tools.**

Thank you