Introduction

Determining the minimum setting depth (MSD) for caprock restoration is critical when evaluating legacy well abandonment or planning future abandonment in fields designated for Carbon Capture and Storage (CCS) project. This decision significantly impacts legacy wells, hydrocarbon production wells, and the abandonment of injection and observation wells.

Method and/or Theory

MSD selection requires thorough consideration of the end-of-injection lifecycle, accounting for maximum injection pressures and the minimum horizontal stress of the caprock. Key factors include plume migration analysis from dynamic-geomechanical coupled simulation—not only the extent of CO_2 penetration but also the timing of its impact on limiting pressure. Fluid gradient selection varies by risk tolerance, ranging from conservative designs using gas gradients to those based on likely fluid mixtures of residual hydrocarbons, CO_2, and water. Additional complexity arises when injecting into multiple reservoirs within the same field, necessitating detailed caprock characterization and plumbing diagrams to assess risks effectively.

Retrieving production packer for plug and abandonment proven to be challenging, especially permanent packer. Sometimes unavoidable solution in the interest of time and cost is to cut tubing and leave the packer and opt for higher caprock. This situation maybe suitable for depleted hydrocarbon field, however, if the field are identified as carbon dioxide storage, this may not be an ideal P&A solution. By doing so, it may pose risk and issue with your CO2 storage such as potential leak or reduce the storage capacity.

Pore pressure increases from injection are expected to elevate minimum horizontal stress within reservoir sections. Due to cooling effect from CO2 injection, there is also a potential reduction in caprock and reservoir fracture gradient. This phenomenon directly influences storage capacity and allowable injection pressures. When combined with plume migration analysis, these insights support decisions on re-entry necessity and timing, as well as the optimization of Monitoring, Measurement, and Verification (MMV) plans.

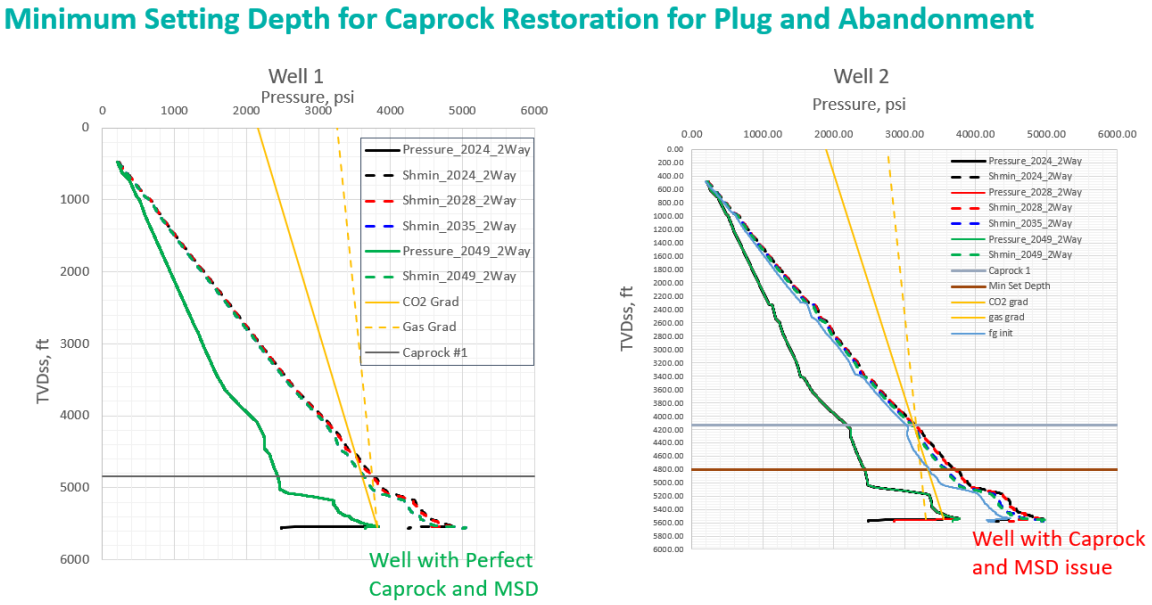

Figure 1 *Graph on the left shows the abandoned well with ideal MSD while graph on the right shows abandoned well with issue with the current MSD for CO_2 injection.*

Conclusions

This study provides practical guidance for addressing technical challenges such as production packer retrieval during abandonment, designing fit-for-purpose re-abandonment strategies, and developing effective MMV plans tailored to project constraints.

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References

N/A