Well Plugging & Abandonment for Well CO₂ Stores – Current Best Practices Decom

Steve Jewell



Well P&A for CO₂ Stores – Current Best Practices

- Well Plugging and Abandonment (P&A)
- CO₂ Storage Wells
- Best Practice

Well Decommissioning Guidelines – Oil & Gas UK

- Revised 2018, Issue 6
- Increased reliance on 'Risk Assessment'
- Hydrocarbons, not CO₂

5.5 Wells Containing CO₂

This paragraph applies to naturally occurring CO_2 . Sequestration of CO_2 is outside the scope of these guidelines.

Note: Future CCS may be identified as an option for the reservoir in a decommissioning programme, if this is the case, the well decommissioning should be designed accordingly.

The barriers placed in a well with significant concentrations of CO_2 should be chosen and designed to withstand the potential effects of the gas on cement, and steel components of the well and on subsurface formations. CO_2 may degrade cement in the presence of water, in particular Portland cement, increasing its permeability. CO_2 will also accelerate corrosion of steel and can increase the permeability of subsurface formations, for example by (thermal) fracturing of shales.]



CO₂ and Portland Cement



Figure 3

Portland cement samples before experiment and after 6 months at 90°C and 280 bars in carbon dioxide fluids (sample located at the interface between both CO_2 fluids). Note the spalling effect observed on the sample core after 6 months of test.

Mitigations ?

'Well Technologies for CO2 Geological Storage: CO2-Resistant Cement', Barlet-Gouédard et. al. Schlumberger *Oil & Gas Science and Technology – Rev. IFP*, Vol. 62 (2007), No. 3, pp. 325-334 Copyright © 2007, Institut français du pétrole

Well P&A for CO₂ Stores – Current Best Practices

Four well types to consider:

- Fully Abandoned Exploration / Appraisal Wells
- Fully Abandoned Development Wells
- Development Wells re-purposed for CO₂ Injection or monitoring
- 'Purpose Built' CO₂ Storage Wells

Well P&A for CO₂ Stores – Current Best Practices

Three crucial considerations for all well types:

- Leakage Risk
- Leakage Tolerance
- Remediation

DECC Study Findings - 2012

- Abandoned E&A and former development wells pose the biggest risk for leakage from a CO₂ store
- Whilst the probability of well integrity failure is real and quantifiable, leakage rates to the biosphere would be very low
- Wells specifically designed for CO₂ service are much less likely to leak, and leakage rates would also be low



<u>References</u>

- 'CO₂ Storage Liabilities in the North Sea An assessment of Risks and Financial Consequences' Appendix A1 – Well Risks (J. Bellarby), DECC May 2012, S. Jewell and W. Senior
- 2. 'A Risk Based Approach for Well Integrity Management Over Long Term in a CO₂ Geological Store', SPE 122510, Le Guen et.al.
- 3. 'CO₂ Sequestration wells the Lifetime Integrity Challenge', SPE 136160, Smith et. al.

DECC Study 2012





Poor well abandonment

Ideal well abandonment

Well P&A Best Practice Summary ?

- Section mill and place a rock-to-rock cement plug across the cap rock
- Use CO₂ resistant cement (several types and brands available) or alternative CO₂ resistant material
- Conduct comprehensive risk management to assess the likelihood and tolerance of leakage

Well Plugging & Abandonment for CO2 Stores – Current Best Practices **Well Decom**

Steve Jewell

