CO2 Capture Project®

CCP PROJECT FACTSHEET

CCP CONTINGENCIES PROGRAM

Detecting, characterizing and intervening in out of zone migration of CO_2

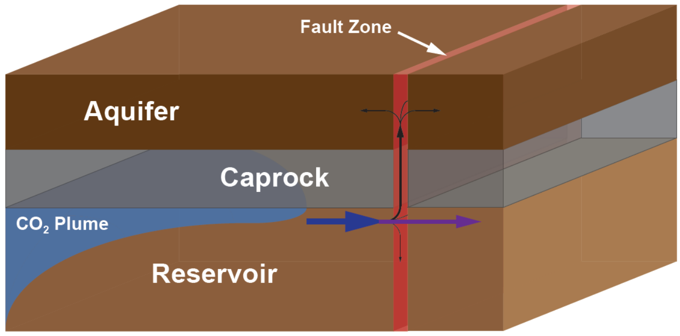
OVERVIEW

Escape of CO_2 from a storage site into groundwater or the atmosphere is one of the most frequently cited concerns about CO_2 Capture and Storage (CCS) and it is essential that ways are found to allay such fears if CCS is to become more widely accepted and adopted. Each potential storage site, whether in deep saline formations or in depleted oil and gas reservoirs, is geologically unique – which represents a risk profile that needs to be managed through field development plans and operational monitoring.

Experience to date at industrial scale CCS projects has shown that in well-chosen sites, with interactive injection management and monitoring, CO_2 is stored securely. Developing the capability to detect, characterize and intervene in unanticipated CO_2 or displaced brine migration will add an additional layer of protection to economically or environmentally important receptors.

While rigorous pre-injection site screening and assessment, operational monitoring, and post injection sealing of wells are the most important safeguards for ensuring the safe and permanent storage of CO_2, confidence still needs to be built around what can be done if CO_2 does unexpectedly migrate from the storage zone.

A CCP program was initiated in 2011 to address this additional safeguard. The aim of the CCP 'Contingencies' Program is to detect, characterize and intervene in out of zone migration of CO_2 or displaced fluids (e.g. brine). The program is a unique initiative that leverages existing industry expertise to favourably impact the future development of CCS. The CCP Storage Monitoring and Verification (SMV) Team has been working with a cross-section of respected experts from academia, national labs and industry consultants on the first phases of the project, producing some intriguing results which may culminate in testing selected technologies in a field experiment.



Remediation of potential CO_2 migration through fault zones is one of the migration scenarios studied. (Image courtesy of C. Zahasky and S. Benson, Stanford Univ.)

THE PROGRAM

DEFINING THE SCOPE (PHASE 1)

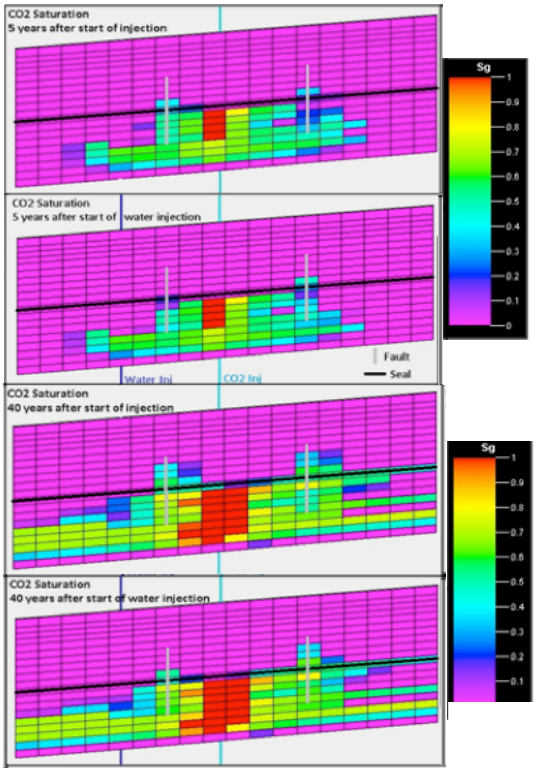
An initial scoping workshop was held in 2011, attracting 35 experts from the oil and gas field services industry, national laboratories and academia. The workshop looked at the vulnerabilities of natural and engineered systems to anomalous CO_2 and brine migration and the potential impacts on a project's effectiveness and compliance, as well as on health, safety and the environment (HSE). From this, a plan for the project was produced, encompassing modelling and technology development.

MODELLING AND SIMULATION OF POTENTIAL CO_2 MIGRATION SCENARIOS (PHASE 2)

Stanford University was selected to conduct Phase 2 of the Program – a modelling-based approach to the detection, characterization and intervention of unexpected CO_2/fluid migration. This involved using geologic models with simulation of CO_2 injection with and without features that would allow CO_2 to migrate out of zone via conduits (e.g. undetected faults). For the migration cases, a range of fracture and fault conduit flow estimates and sensitivity to detecting CO_2 migration via surface seismic was estimated and intervention techniques simulated. Injection profile management, above-seal water injection and CO_2 extraction, along with injection of sealants into the top seal breach were simulated. Other specialized studies, including efficacy of commercial well sealants and novel chemical sealants were also conducted.

The significant results of the studies were presented at the end of 2013. They include:

- Limiting CO_2 injection stops the bulk of out of zone CO_2 migration. Hydraulic controls are effective but would have to be operated over an extended period of time and CO_2 injection would probably have to cease
- Surface seismic detection and characterization of unexpected CO_2 migration is limited but could be improved using above seal pressure monitoring and borehole seismic techniques
- Injection of sealants could be highly effective and perhaps allow continued injection of CO_2. More development work would be needed, however, to extend the setting time under subsurface conditions.
- Conduit 'self-healing' via salt and other mineral precipitation may occur under some circumstances.



INTERVENTION TECHNOLOGY DEVELOPMENT (PHASES 3 AND 4)

The last two stages of the project aim to identify a suitable site to test an intervention technology with the development of a detailed characterization, engineering, surveillance and analytical plan (Phase 3), then potentially to deploy it (Phase 4).

The design work and ultimately deployment of a 'fracture-sealing' experiment is proposed for the Mont Terri Underground Lab in Jura Canton, Switzerland. The experiment would entail:

- Creating multiple sets of isolated hydraulic fractures into the rock via an 'active' well
- Drilling multiple 'passive' wells through the fracture planes
- Completing each of these wells into a single fracture set and establishing water circulation with the active well
- Injecting selected sealants (conventional well sealant, biofilming microbes with substrate, 'triggerable' nano particle 'smart gel') into the active well and through the fractures with monitoring of pressure and fluid flow rate to assess sealing
- Overcoring the rock volume to analyze the sealing with respect to fracture aperture size. Geophysical monitoring boreholes would be drilled prior to operation for pre- and post-injection characterization of acoustic property changes in the rock volume.

A feasibility study has been conducted for the fracture-sealing experiment at Mont Terri with further deployment-ready engineering work considered for 2014. Depending on the results of the Mont Terri fracture sealing experiment (if deployed), CCP would investigate other options for further testing of through-conduit CO_2/brine flow mitigation. Possibilities include experiments in other underground laboratory facilities or deep well-well settings where seal rock clay minerals have characteristics closer to those expected at CO_2 storage facilities (i.e. smectite to illite conversion has occurred).

ABOUT THE CO_2 CAPTURE PROJECT

The CO_2 Capture Project (CCP) is an award-winning partnership of major energy companies working to advance the technologies that will underpin the deployment of industrial-scale CO_2 capture and storage. To find out more visit www.co2captureproject.org