Pressure control and conformance management for safe and efficient CO₂ storage – an overview of the Pre-ACT project

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Abstract

The main storage-related challenges for accelerated deployment of CCS are capacity, confidence and cost. Pre-ACT is an industry-driven research project which addresses these challenges by focusing on improving strategies for monitoring and management of pore pressure distribution in the storage reservoir.

Pre-ACT will develop pressure-driven decision support protocols (Pre-ACT Protocols) for safe and cost-effective reservoir monitoring. These protocols will enable the operator to maximize CO₂ storage capacity and quickly turn monitoring data which suggest non-conformance into plans for corrective action.

Pre-ACT has access to a wide and relevant set of monitoring data from key demonstration sites across the world. This will be used to calibrate, verify and demonstrate the value of Pre-ACT’s pressure-driven decision support protocols. The industrial partners in Pre-ACT (Total, Statoil, Shell and TAQA) will be instrumental in securing the relevance and applicability of the tools developed in the project and bring their operational experience and perspective.

The project, coordinated by SINTEF Industry, started in 2017 and will run until August 2020. Five countries with strong commitment to CCS are represented in the consortium: Norway (SINTEF, NORSAR, and Statoil), Germany (GFZ), the Netherlands (TNO, Shell, and TAQA), UK (BGS and PML) and France (Total). Pre-ACT has also established links with projects in the US (Bell Creek and Decatur) and Australia (Otway).

Pre-ACT comprises five technical work packages, designed to build the different elements in the pressure driven decision support protocols, see Figure 1.
WP1 deals with the development and demonstration of methods to model pressure build-up and distribution. WP2 and WP3 deal with development and demonstration of a modelling-monitoring loop for conformance assessment. These early work packages utilise a unique compilation of existing and new characterisation, monitoring, and performance data sets from relevant pilot and field sites. WP4 will derive recommendations for decision making procedures. In WP5, North Sea case studies will be carried out, demonstrating the value of the protocols developed in Pre-ACT. The project also includes first of a kind experiments at the ECCSEL Svelvik Field Lab, southern Norway (Ringstad et al., submitted).

WP1 undertakes the fundamental research to determine pressure sensitivity during CO₂ injection and provides the key learnings for effective pressure control and monitoring used throughout Pre-ACT. The work package investigates how pressure builds up for a range of typical storage reservoir types, how it propagates through a reservoir, and ultimately how it dissipates towards stabilisation. This provides the basis for linking the storage site specific features with the conformance parameters. Pressure control strategies and their potential environmental impact will also be investigated.

In WP2 a minimum-cost active-passive monitoring concept, as an alternative to expensive repeated 3D seismic surveys, will be developed. WP2 will also devise and carefully test a pragmatic approach for saturation-pressure discrimination supported by experimental campaigns at the Svelvik site. In addition to the new Svelvik data, existing pilot project data will be used. Methods in WP2, as e.g., multi-physics simulation and rock-physics inversion, will provide crucial input to the conformity investigations in WP3.

WP3 will develop quantitative criteria to assess the conformance during CO₂ storage and define conditions for irregularity or non-conformance. One of the key objectives is to translate monitoring results into conformance levels that can be communicated to operators and stakeholders. Monitoring technologies will also be evaluated using a newly developed Value of Information assessment tool.

The work on understanding pressure propagation in the formation (WP1), the novel monitoring concepts (WP2) and the conformity investigations (WP3) will bring crucial information for decision making purposes. In close collaboration between operators and R&D partners, within a series of workshops, WP4 investigates the options and suggests optimal routes of actions if a pressure-based conformance test fails.

In the second half of the project, WP5 will demonstrate that the methodologies developed can answer to the needs of the industry through a set of case studies ranging from storage in saline aquifers such as the Smeaheia/Troll area (North Sea) to storage in depleted gas fields, offshore Netherlands. Each case study illustrates a specific challenge, and the Pre-ACT Protocols and monitoring plans will address the needs for a safe and cost-effective storage. WP5 will also ensure communication of results to informed stakeholders.
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