Evaluation of the CO_2 plume migration for the Northern Lights project

Szczepan Polak, Ingveig Torsnes, Elvira Milovanova

The Northern Lights project is a part of the Norwegian full-scale CCS project expected to come on stream in 2024. CO_2 is planned to be injected in the Aurora storage complex, a dipping aquifer, that consists of the Lower Jurassic intra-Dunlin Group sandstones with the Drake Formation as the primary seal. There are no structural closures within the exploitation license, and with time, the structural dip will cause that some of the injected CO_2 will migrate northwards, towards the structural closure outside the current license. In order to avoid third party exposure, injected CO_2 must be confined within the license boundary for 30 years from start of injection. Therefore, the amount of CO_2 that can be injected is partially governed by the CO_2 plume migration speed.

A reservoir modeling process has been designed for the Aurora area to evaluate reservoir uncertainties in an integrated way and within a compressed timeframe between drilling of the confirmation well and the project investment decision. An ensemble of model realizations has been generated and simulated to cover the uncertainty span. Automated analysis of simulation results such as maximum CO_2 plume travel distance and quantity of CO_2 migrating out of the license allowed to identify the main parameters impacting these quantities.

Uncertainty analysis showed that reservoir permeability, relative permeability model, and reservoir flow barriers have the strongest impact on CO_2 migration speed. The reservoir monitoring plan has been designed to estimate CO_2 migration speed from 4D seismic surveys. A risk mitigation strategy has been developed with a predefined action plan addressing unexpected fast CO_2 migration.

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