The Role of Risk Assessment in Planning an MMV Program for CO2 Storage

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Summary

Risk assessment provides a powerful framework for the planning, development and ultimately, implementation of a measurement, monitoring and verification (MMV) program for the geological storage of CO_2. As an initial step in the planning process for an MMV program,the mechanisms that control past and future behavior need to be understood through reservoir simulation which is based on a fundamental understanding of the processes active in the ground at the pore level and guided by the injection/production and monitoring data as it becomes available. Simulations are utilized to predict temporal and spatial development of the injected gas, including the effect of geochemical reactions on trapping of CO2 and on long term porosity and permeability, the influence of caprock and wellbore integrity, the impact of thermal/compositional gradients in the reservoir, pathways of the CO2 out of the reservoir, the importance of secondary barriers, effects of unplanned hydraulic fracturing, the extent of upward migration of CO2 along the outside of the well casing, impacts of cement dissolution, and problems due to wellbore failure and hydrogeological disruptions.

Three levels of monitoring: operational, verification and environmental, represent an increasing progression of monitoring intensity, duration and technology development and are described as follows:

1. Operational refers to the monitoring/control of in situ processes by changes in injection/production strategy based on the measured variables. Prior to injection it is important to establish a baseline to help identify any changes due to the injection. Minimal requirements are specified by regulatory requirements and additional operations monitoring is guided by ongoing complexities of injection and production.
2. Verification refers to additional measurements that improve the understanding of complex processes occurring in situ. This level of monitoring is generally linked intimately to predictive modelling. Models are refined based on the history of the measured variables, important mechanisms are hypothesized, and future behaviour is predicted.
3. Environmental refers to monitoring aimed at safeguarding against risks to health, safety and the environment. Depending on the risk level of the project, aspects of environmental monitoring may be part of operational monitoring.

The use of risk tools such as features, events and process (FEP) identification and sceanrio development are a critical component in the MMV planning process because selection of an appropriate measurement method and/or the selection of instrumentation are based on whether it can provide the data necessary to answer a particular technical question – if there is no question, there should be no instrumentation. This step is applicable for all three levels of monitoring stages:

operational, verification and environmental. Monitoring requirements are likely to be proportional to the scale of the project, and should take into account a range of other anticipated risk factors.