Dylan R. Harp, Philip H. Stauffer, Daniel O'Malley, Zunsheng Jiao, Evan P. Egenolf, Terry A. Miller, Daniella Martinez, Kelsey A. Hunter, Richard S. Middleton, Jeffrey M. Bielicki, Rajesh Pawar, 2017, Development of robust pressure management strategies for geologic CO_2 sequestration, *International Journal of Greenhouse Gas Control,* vol. 64, September 2017, Pages 43–59.

Highlights

- A numerical model of the Rock Springs Uplift Carbon Storage Site in southwestern Wyoming is used to illustrate a pressure management strategy selection approach.
- The demonstration focuses on the uncertainty in the permeability field, assuming that the seismically-derived permeability field is the best available information and can be used as the nominal values for strategy selection.
- The approach then provides a formal mathematical approach to quantify the robustness of alternative pressure management strategies.

Abstract Injecting CO_2 into deep geologic formations for permanent storage can potentially lead to leakage or induced seismicity if the overpressures exceed the fracture gradient or fault reactivation pressure. Strategies that remove reservoir fluids before or after injection may reduce these risks. But, even extensively characterized reservoirs can have substantial gaps in characterization necessary for developing optimal deterministic or even probabilistic pressure management strategies. The characterization data may not provide well-defined bounds or distributions of reservoir parameters or conditions (permeability, fault locations, fracture gradient, fault reactivation pressure). To assess the impact of these uncertainties, we present an approach for evaluating alternative pressure management strategies based on their robustness of meeting project performance criteria. We quantify the robustness of alternative strategies against several criteria: (1) exceeding fault reactivation pressure, (2) failing to inject a desired quantity of CO_2, (3) exceeding a maximum quantity of extracted brine, and (4) failing to reach a desired extraction efficiency. Our approach allows nuances of competing and complimentary criteria to be quantitatively evaluated in a manner and in a level of detail not possible with optimization approaches. We illustrate the fundamentals of the approach on a simple one-dimensional analytical example using the Thiem equation. We demonstrate the approach using a numerical flow and transport model with uncertain heterogeneous permeabilities using data and site characteristics from the Rock Springs Uplift Carbon Storage Site in southwestern Wyoming.

Keywords Pressure management; Decision analysis; Brine extraction; Robustness

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