Federal UIC Regulations for Geologic Sequestration: An Integrated Approach of Site Characterization, Modeling, and Monitoring

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In July 2008, US EPA released proposed regulations for permitting of carbon dioxide underground injection wells associated with geologic sequestration (GS) projects. The proposal was published by the Underground Injection Control (UIC) program, which is tasked with protection of the nation's groundwater from injection activities. A final rulemaking is anticipated in late 2010 or early 2011.

The proposal would require an integrated program of site characterization, computational modeling, and site monitoring at GS sites. These activities would be performed iteratively, and would be ongoing throughout the lifetime of the project and for an extended period after injection ceases. The overall objective of this integrated program would be track the migration of the carbon dioxide plume and induced pressure front for the purpose of ensuring that drinking water aquifers are not endangered.

Computational modeling requirements would be incorporated to address the Area of Review (AoR) component of the UIC program, which defines the region surrounding the injection well wherein drinking water aquifers may be endangered. For existing classes of UIC wells, the AoR is determined via a fixed radius around the injection well, or by a simple radial calculation. The new GS regulation would require multiphase fluid modeling for AoR delineation. Furthermore, reevaluation of the AoR delineation would be required periodically during the project lifetime. AoR reevaluations would be based on changes to the computational model, incorporating any pertinent monitoring data (i.e., model calibration) and newly identified site geologic features.

Existing modeling studies have demonstrated the use of modeling in design of GS projects, interpretation of site characterization data, assessment of potential leakage through faults, fractures and abandoned well bores, design of site monitoring strategies, as well as model calibration to site monitoring data. Sensitivity analyses have demonstrated that model results are sensitive to several parameters prone to a significant degree of uncertainty such as relative permeabilitysaturation functional relationships. Preliminary comparisons of site monitoring data from early GS projects to model predictions demonstrate the necessity of ongoing model calibration.

A variety of monitoring activities would be required by the proposal, including regular testing of the injection well to ensure mechanical integrity, monitoring of groundwater quality and fluid pressures, and in some cases monitoring of soil gas and surface air for detection of carbon dioxide leakage. Although no prescriptive technologies would be mandated, monitoring would be required in order to track the evolution of the carbon dioxide plume and pressure front. It is anticipated that in most cases a combination of direct sampling via monitoring wells and geophysical surveying would be employed for this purpose.