the ENERGY lab

PROJECT FACTS

Carbon Sequestration

Comprehensive, Quantitative Risk Assessment of CO_2 Geologic Sequestration

Description

The National Energy Technology Laboratory (NETL), the only national lab owned and operated by the U.S. Department of Energy (DOE), emphasizes computer simulation and risk assessment of potential CO_2 Geologic Storage (GS) sites, as a significant component of its monitoring, verification, and accounting (MVA) program. MVA utilizes both simulation and risk assessment to provide accurate accounting of stored CO_2 and to develop a scientific basis to support decisions related to the permanence of CO_2 GS. Proper use of the MVA information will ensure that GS of CO_2 does not adversely impact human health and/or the environment. Research will focus on identifying and quantifying potential risks to humans and the environment from GS and potentially provide a basis for establishing carbon credit trading markets.

This four-year project—performed by Headwaters Clean Carbon Services LLC in partnership with Los Alamos National Laboratory (LANL), the University of Utah, and Marsh Risk Consulting—will develop an innovative, advanced, process-based risk assessment model to determine quantitative risks and predict quantitative impacts at CO_2 capture and GS. The model will be applied to field project sites that can be readily integrated with advanced simulation models and MVA technologies. The project uses a Failure Modes and Effects Analysis (FMEA) approach to convert and integrate widely accepted risk assessment approaches into a common framework that allows an in-depth, comprehensive, quantitative risk assessment that can be tailored to assess any CO_2 GS site. FMEA is a proven method of identifying, analyzing, prioritizing, quantifying and mitigating risks. The results are displayed in a spreadsheet format that is easy to understand, improve, expand, or tailor to the needs of a site-specific project.

Primary Project Goal

The primary project objective is to develop and apply an innovative, advanced, process-based FMEA risk assessment model that can be readily integrated with advanced simulation models and MVA technologies to determine quantitative risks and predict quantitative impacts at CO_2 sequestration project sites.

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PARTNERS

Los Alamos National Laboratory

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COST

Total Project Value
$2,349,836

DOE/Non-DOE Share
$1,879,867 / $469,969

Accomplishments

This project was awarded on October 1, 2009. The specific objectives for each phase of work are as follows:

- **Phase 1:** Identify, describe and characterize potential risks for CO_2 sequestration.
- **Phase 2:** Develop a computer-based model for identifying, analyzing, quantifying, and mitigating risks at CO_2 sequestration field project sites.
- **Phase 3:** Apply the risk assessment model to three known CO_2 sequestration projects to evaluate the effectiveness of the model.

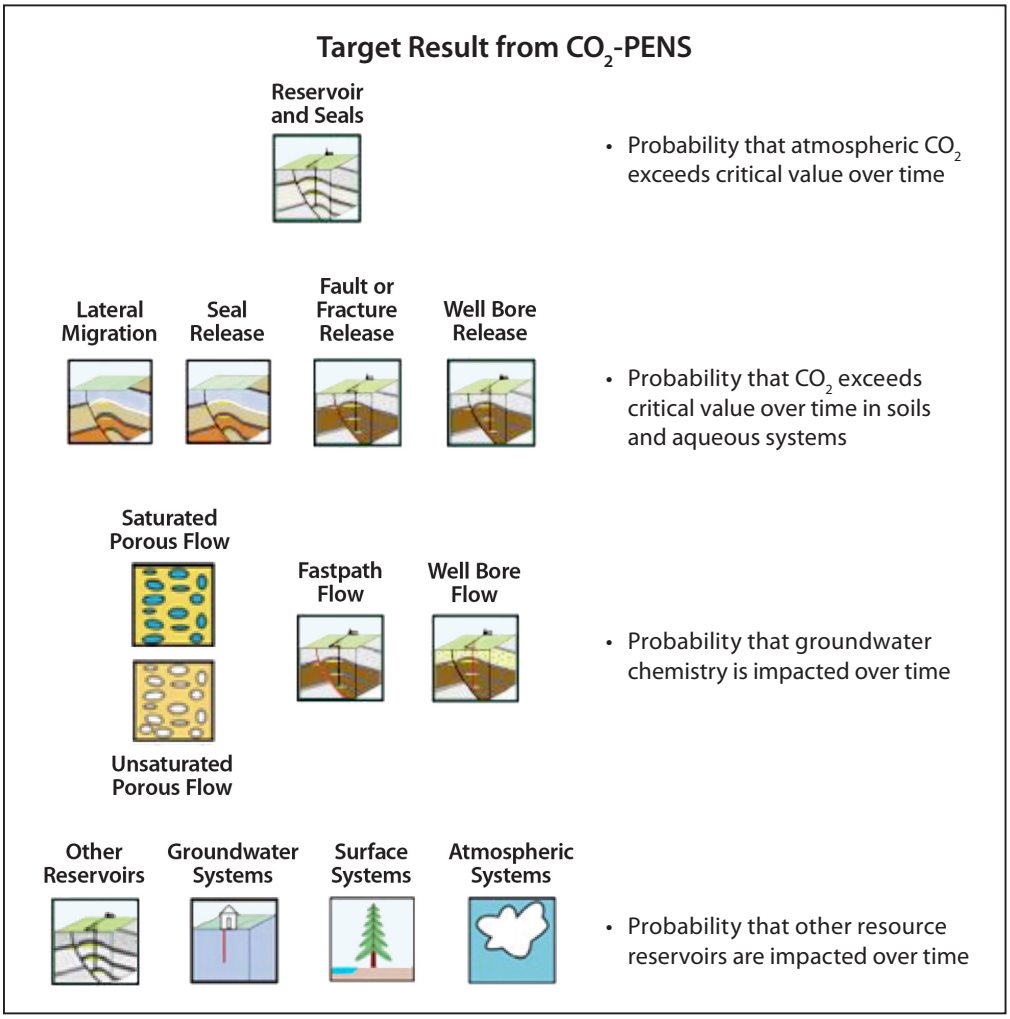
The project team will accomplish the above objectives by developing a model that clearly explains the risks so that all stakeholders can readily understand them. There is a wide range of stakeholders who can affect the success or failure of a CO_2 geologic sequestration project, including regulators, scientists, engineers, project developers, bankers, operators, insurers, environmentalists, and the general public. These people come from many backgrounds and disciplines, and most will not take the time to read a 500-page document nor try to master a probabilistic computer simulation model. They need information in an easily accessible, straightforward, and in a concise format without being barraged by acronyms and terms that are unfamiliar to them.

The FMEA tool is displayed as a table (spreadsheet) that can be tailored to a specific project, updated, improved, or expanded. It accepts input from a wide range of sources (simulations, field data, or experience) and unifies the information into a common, concise format.

The FMEA framework enables the risks to be sorted, prioritized, quantified, and analyzed in a variety of ways. Risks may be prioritized by the probability of failure occurring, severity of the effect of failure, and difficulty of pre-detecting a failure. They can be further quantified using computer simulation modeling, probabilistic calculations, and field experience. The model can be readily integrated with advanced simulation models and MVA technologies, and will be applied to existing sequestration projects.

Benefits

The expected outcome of this project is that a comprehensive, quantitative CO_2 risk assessment tool will be developed that can be customized to assess site-specific projects, integrated with other CO_2 sequestration assessment tools, and be easily modified, improved, or expanded. This tool will be made available to regulators, scientists, engineers, bankers, project developers, operators, insurers, environmentalists, and the general public in a form that can be easily understood and used by all of the different stakeholders.



Example of probabilistic risk assessment from LANL's CO_2-PENS model, which is an important aspect of a comprehensive FMEA risk assessment framework.