

Integrated Monitoring Program for a Combined CO₂ Enhanced Oil Recovery and CO₂ Storage Project in the Bell Creek Oil Field

John A. Hamling, Charles D. Gorecki, Jason Braunberger, Barry Botnen, Hui Pu, Ryan Klapperich, Edward N. Steadman, and John A. Harju

Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

ABSTRACT

Category: Reservoir Monitoring and Management

The Plains CO₂ Reduction (PCOR) Partnership, led by the Energy & Environmental Research Center (EERC), is working with Denbury Onshore LLC (Denbury) to determine the effect of a large-scale injection of carbon dioxide (CO₂) into a deep clastic reservoir for the purpose of simultaneous CO₂ enhanced oil recovery (EOR) and CO₂ storage at the Denbury-owned Bell Creek oil field. CO₂ will be injected into an oil-bearing sandstone reservoir in the Lower Cretaceous Muddy Formation at a depth of approximately 4500 feet (1372 meters). The Muddy Formation within the boundaries of the Bell Creek oil field is characterized by high permeability (425–1175 mD) and high porosity (25%–35%), with reservoir pressures and temperatures that will maintain injected CO₂ in a supercritical state and are near conditions required for miscibility of CO₂ in the oil. The activities at Bell Creek will inject an estimated 1.1 million tons of CO₂ annually, most of which will be permanently stored.

The PCOR Partnership has developed an approach that integrates site characterization; modeling and simulation; risk assessment; and monitoring, verification, and accounting into an iterative process to produce meaningful results for large-scale CO₂ storage projects.

The reservoir-monitoring program will utilize a preinjection baseline data set and a staged injection monitoring approach to allow for time-lapse data acquisitions collected during key intervals of the EOR operation.

The surface-, near-surface-, and reservoir-monitoring programs are engineered to have minimal impact on the commercial EOR project and address the challenges of limited wellbore access and the reservoir complexities experienced during an active EOR project. Monitoring data acquisitions are designed to enhance commercial EOR data, to evaluate the performance of both the CO₂ EOR and CO₂ storage projects and to establish the relationship between a CO₂ EOR process and long-term storage of CO₂.