TECHNICAL PROGRESS REPORT

for

JULY-SEPTEMBER 2006
NOVEL CONCEPTS RESEARCH IN GEOLOGIC STORAGE OF CO_2
PHASE III

THE OHIO RIVER VALLEY CO_2 STORAGE PROJECT

Contract No. DE-AC26-98FT40418

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ABSTRACT

As part of the Department of Energy's (DOE) initiative on developing new technologies for the storage of carbon dioxide (CO_2) in geologic reservoirs, Battelle has been investigating the feasibility of CO_2 sequestration in the deep saline reservoirs of the Ohio River Valley region. In addition to the DOE, the project is being sponsored by American Electric Power (AEP), BP, Ohio Coal Development Office (OCDO) of the Ohio Air Quality Development Authority, Schlumberger, and Battelle. The main objective of the project is to demonstrate that CO_2 sequestration in deep formations is feasible from engineering and economic perspectives, as well as being an inherently safe practice and one that will be acceptable to the public. In addition, the project is designed to evaluate the geology of deep formations in the Ohio River Valley region in general and in the vicinity of AEP's Mountaineer Power Plant, in order to determine their potential use for conducting a long-term test of CO_2 disposal in deep saline formations.

The current technical progress report summarizes activities completed for the July-September 2006 period of the project. As discussed in the following report, the main accomplishments were reservoir modeling for the Copper Ridge "B-zone" and design and feasibility support tasks. Work continued on the development of injection well design options, engineering assessment of CO_2 capture systems, permitting, and assessment of monitoring technologies as they apply to the project site. In addition, an integrated risk analysis of the proposed system was completed. Finally, slipstream capture construction issues were evaluated with AEP to move the project toward an integrated carbon capture and storage system at the Mountaineer site. Overall, the current design feasibility phase project is proceeding according to plans.

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EXECUTIVE SUMMARY

This is a Quarterly Technical Progress Report for Contract DE-AC26-98FT40418. It has been prepared in accordance with the requirements of the National Energy Technology Laboratory (NETL). The reporting period for the current document is July to September 2006.

The purpose of this project is to evaluate the geology of deep formations in the Ohio River Valley region and to conduct a long-term test of carbon dioxide (CO_2) injection/storage in deep saline formations at an active power plant site. As discussed in the following report, the main accomplishments were reservoir modeling for the Copper Ridge "B-zone" and design and feasibility support tasks. Work continued on the development of injection well design options, engineering assessment of CO_2 capture systems, permitting, and assessment of monitoring technologies as they apply to the project site. In addition, an integrated risk analysis of the proposed system was completed. Finally, slipstream capture construction issues were evaluated with AEP to move the project toward an integrated carbon capture and storage system at the Mountaineer site. Overall, the current design feasibility phase project is proceeding according to plans.

1.0 INTRODUCTION

The main objective of this project is to evaluate the geology of deep formations in the Ohio River Valley region and to conduct a long-term test of carbon dioxide injection/storage in deep saline formations at an active power plant site if the project sponsors see fit. This work supports the overall project objective of demonstrating that CO_2 sequestration in deep formations is feasible from engineering and economic perspectives, as well as being an inherently safe practice and one that will be acceptable to the public.

2.0 EXPERIMENTAL

The main experimental activity undertaken during the reporting period was reservoir simulations of CO_2 injection into the Copper Ridge Dolomite. Work also continued on design and feasibility support tasks designed to move the project toward an integrated carbon capture and storage system at the Mountaineer site. Major accomplishments were related to the following topics:

- Several STOMPCO_2 reservoir simulations were completed for the Copper Ridge Dolomite "b-zone" based on results of reservoir tests and field data. Initial results show that the injectivity is focused on the thin high permeability zones within the carbonate unit (Figure 1). It was necessary to refine the model setup to account for the different geologic nature typical of the carbonate rock systems. Additional simulations are being completed to estimate injection rates for this zone with more certainty.
- Work continued on the CO_2 supply, injection and monitoring system design. The proposed capture system from Fluor was evaluated for chemical and waste handling aspects, permitting issues for capture, power and steam requirements, system optimization, and cost discussions. Battelle and AEP also continued to plan the slipstream outlet construction specifications in relation to the flue gas desulphurization system under construction at the plant as well as the proposed capture system.
- Battelle worked with AEP, MHI, Fluor, and other companies to evaluate the state-of-the-art capture options for a reliable yet innovative pilot-scale capture system (up to 100 tonnes/day) for CO_2 supply for an integrated capture and injection demonstration.
- An integrated risk analysis was completed for the site, including simulated leakage scenarios, impact in shallow groundwater, soil, and air from hypothetical leakage.

3.0 RESULTS AND DISCUSSION

The following sections summarize the major activities and their outcomes for the reporting period under each task of the project.

Task 1 – Geologic Data Assessment

Task 1 includes subsurface geologic assessment in the vicinity of the field site based on pre-existing information. All activities under Task 1 of the Statement of Work have been completed, and Battelle has developed a thorough understanding of the geologic framework for the site's deep saline reservoirs, caprock formations, and coal seams. An Interim Topical Report on the findings was submitted to NETL on August 3, 2003.

Task 2 – Seismic Survey

The main tasks related to the seismic survey have been completed including: design of a survey through injection well site, acquisition of 11 miles of seismic reflection data, processing the data, interpretation of the results, analysis of the feasibility of seismic monitoring of CO_2 in the region, and reporting. Remaining elements of task 2 include final determination of the monitoring arrangements for vertical seismic profiling and passive seismic monitoring, which will be completed at the end of the current phase.

Task 3 – Borehole Drilling and Testing

All major activities associated with Task 3 have been completed. The main remaining effort in this task is review of the Copper Ridge Dolomite reservoir testing analysis by reservoir engineers to verify results. We also plan to prepare a manuscript describing the borehole injectivity characterization efforts for publication in a peer-reviewed journal.

Task 4 – Reservoir Simulations

Several STOMPCO_2 reservoir simulations were conducted to model the injection of CO_2 in the Copper Ridge Dolomite "b-zone." Initial results show that the injectivity is focused on thin high permeability zones within the carbonate unit (Figure 1). It was necessary to refine the model setup to account for the discontinuous distribution of permeable zones in this carbonate rock system and achieve a better match between the model based and field-based transmissivity. Additional simulations are being completed to estimate injection rates for this zone with more certainty. Initial results suggest that significant injection rates may be possible in this carbonate zone, consistent with the observations from wireline logs and reservoir testing in the field.

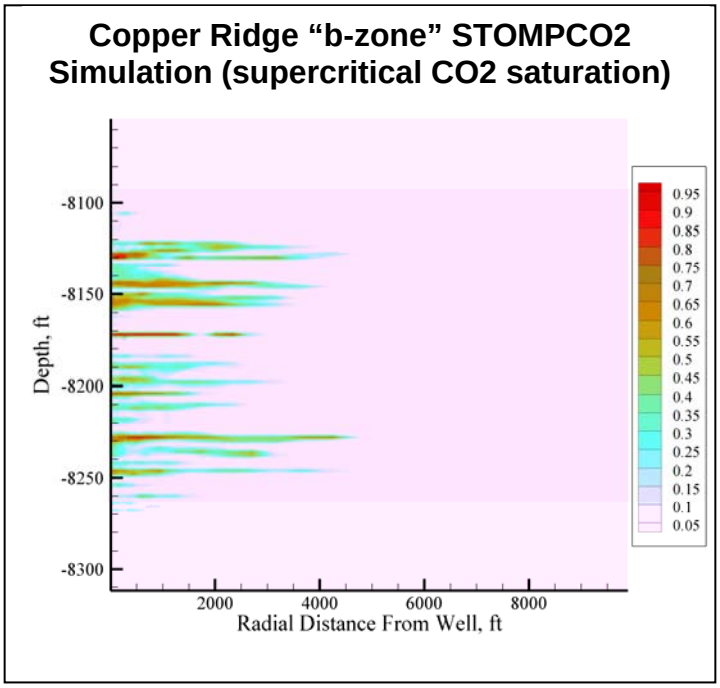

Figure 1. Example of Copper Ridge "b-zone" STOMPCO_2 Simulation

Task 5 – Design the Future Injection and Monitoring Facility and Prepare Regulatory Permits

CO_2 supply, injection and monitoring system design proceeded in this quarter, with a specific emphasis on CO2 capture system. Fluor engineers visited the Mountaineer plant in August to examine the site in relation to proposed capture instrumentation. The meeting between Battelle, Fluor, and AEP including a site walk to discuss the potential location of the capture unit relative to the ongoing construction at the plant, the proposed capture system design, chemical and waste handling aspects, permitting issues for capture, power and steam requirements, system optimization, and cost discussions. Similar visits with MHI have already occurred in the past. Battelle and AEP also continued to ensure the placement of the

slipstream outlet from the flue gas desulphurization system under construction at the plant to the proposed capture system.

Work also continued on a Draft Underground Injection Control permit for the Mountaineer project. While the permit class and final system specifications have not been determined, the permit requirements and pertinent contacts in West Virginia were re-examined given recent developments in EPA regarding regulation of CO_2 sequestration. Work also continued on developing a more detailed monitoring plan.

Task 6 – Risk Assessment and Stakeholder Interactions

Risk Assessment – An integrated risk analysis of the site was completed, including the simulated leakage scenarios, and impact in shallow groundwater, soil, and air from hypothetical leakage scenarios. This analysis included numerical modeling of the CO_2 injection in the Rose Run Sandstone and potential for mobilization into the overlying rock layers. This analysis indicated that there is almost no mobilization of CO2 beyond the immediate caprock in contact with the injection reservoir and the likelihood of any leakage into near-surface geologic layers is negligible at least for the pilot-scale testing. In addition, consequence assessment was conducted based hypothetical leakage scenarios and literature values of probable consequences of leakage. Based on this, no significant risk issues have been identified for the pilot-scale testing. A letter report summarizing the analysis was completed.

Stakeholder Outreach - The stakeholder interaction activities continued with the main focus on local and regional stakeholders and development of the project announcement materials. The key activities included monitoring various news releases related to the potential CCS projects in southeastern Ohio and other locations. Several aspects of the project were included in a presentation to the Ohio Consumers Council in August.

Task 7 – Project Briefings and Meetings

- A detailed overview of the CCS technologies and the Mountaineer project were presented in July at a heavily attended seminar on CCS in Taipei as well as during meetings with Taiwan Power and Chinese Petroleum Corporation.
- Several aspects of the project were included in a presentation to the Ohio Consumers Council in August.
- A meeting was held in August between Battelle, Fluor, and AEP at the Mountaineer Plant to discuss construction of a pilot-scale capture system at the plant.
- A project overview was presented to German power company RWE, a potential co-sponsor of the future phases, in Germany in September.

Task 8 –Building the Regional Geologic Framework

Battelle continues to monitor ongoing or planned drilling activity in the region for opportunities to fill gaps in geologic data for deeper formations with the long-term goal of building a geologic framework for potential storage and containment zones in the Ohio River Valley region.

4.0 CONCLUSION

The project remains on track to complete all major tasks during the 2006 calendar year. Overall, the project is proceeding to pilot demonstration phase, and a strong team has been assembled to accomplish this undertaking. During the reporting period, substantial progress was made in the planning and design of a pilot-scale CO_2 capture and injection demonstration at the Mountaineer site. Reservoir simulations suggest significant injection potential in the Copper Ridge “b-zone”. In addition, construction items related to the slipstream capture and separation system were addressed. As a first-of-a-kind system, this

work involves numerous challenges, but a diverse range of resources are being utilized to meet the challenges.

4.1 Future Activities

With the completion of the reservoir simulation, the remaining focus of the project will shift to the capture and injection system design issues. During the next few months, the following areas of emphasis are anticipated:

- Continuing development of injection well design and monitoring system options
- Working with MHI and Fluor to develop more detailed design plans for the capture system
- Completing simulations of injection in Copper Ridge dolomite
- Finalizing environmental assessment and underground injection permit materials as much as possible for the proposed CCS system
- Extending the modeling effort to risk assessment task.
- Working with DOE, AEP, and other project sponsors to determine the contract mechanism for moving the project to the field implementation stage.

5.0 REFERENCES

No references cited.