OHIO COAL DEVELOPMENT OFFICE
ANNUAL PROJECT ABSTRACT
AS OF DECEMBER 2004

1. PROJECT SPONSOR:

Battelle
505 King Avenue
Columbus, OH 43201

2. PROJECT MANAGER/TITLE:

Neeraj Gupta
Research Leader

3. OCDO GRANT NO. CDO/D-99-16

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5. PROJECT TITLE:
Demonstrating Feasibility and Safety of Geologic Disposal of CO_2

6. PROJECT TERM FROM: May 1, 2002 **TO:** June 30, 2005

7. PROJECT UPDATE _X____ --OR-- **FINAL REPORT** _____

8. BUDGET: *Updated to reflect increased non-OCDO cost share as of 12/31/2004*

CO-SPONSORS	**Cash ($)**	**Estimated in-kind ($)**
OCDO	200,000	0
BATTELLE	25,000	0
DOE/NETL	4,557,558	0
AEP	175,000	>100,000
BP	200,000	>100,000
SCHLUMBERGER	0	>400,000
Other in-kind	0	>500,000
TOTAL COST	**4,837,797**	**>1,100,000**

ABSTRACT

9. OVERVIEW OF PROJECT & OBJECTIVES:

During the summer of 2002, DOE selected Battelle's proposal on geologic sequestration of CO_2 in deep saline formations (called the Ohio River Valley CO_2 Storage Project or the Mountaineer Project) for funding under the Core R&D component of the sequestration program. That project was funded under the Phase III of the Novel Concepts in Carbon Management program and as part of the down-selection process from Phases I and II of the program. In addition to DOE funding, this effort has been supported by extensive contributions from such as AEP, BP, the Ohio Coal Development Office, Schlumberger, Pacific Northwest National Laboratory (PNNL), and Battelle. The project also has involved a number of other researchers in various organizations within the United States and internationally, thus providing additional value for the DOE project.

The overall objective of the Ohio River Valley CO_2 Storage Project is to prove the efficacy, safety, and public acceptability of geologic sequestration of CO_2 through systematic site characterization and carefully conceived injection and monitoring experiments under real-life operational constraints in the Ohio River Valley Region, home to the largest concentration of coal-fired power plants in the nation. The project approach is based on the premise that site-specific field characterization and realistically-scaled field experiments are essential for understanding geologic sequestration technology and for moving this technology from laboratory-scale assessments to real-world deployment. Appropriate-scale field efforts need to be conducted for testing the technical, implementation, regulatory, economic, and public perception aspects of geologic sequestration as well as for building stakeholder confidence. These field tests must be conducted at or close to the kinds of large CO_2 point sources that are precisely the kinds of high value economic assets (e.g., billion dollar plus electric power plants) that are likely going to adopt CCS technologies in the future. Furthermore, the field effort must be undertaken in a step-wise manner so that the knowledge gained from early steps (such as characterization, laboratory experiments, and reservoir simulation) is fully utilized in developing and optimizing the subsequent steps.

In addition to the site-specific tests, a concerted effort has been made to improve geologic understanding of the deep formations in the region. This has been done through collaboration with ongoing oil/gas drilling in the region by collecting geologic data and samples in two deep wells in southeastern Ohio.

10. WORK TO DATE & CONCLUSIONS:

During the previous year (2003) the major field activities for the project had been completed. These included preliminary geology assessment; seismic survey; drilling and sampling in a ~9,100 ft deep borehole; wireline logging; and stakeholder outreach. The activities during 2004 calendar year built upon 2003 achievements:

- Conducted field tests to determine ambient pressure and injection potential in selected reservoirs and quantified permeability of the reservoirs and overlying caprock formations.
- Collected and analyzed brine samples from selected zones to evaluate potential interactions between CO_2 and brine
- Completed interpretation of the seismic data
- Completed testing of the core samples. About 300 ft of deep core has been provided to Ohio Geological survey for permanent storage and is available to researchers for further studies.
- In collaboration with Stanford University, a detailed geomechanical assessment of the area based on well data has been completed.
- Advanced reservoir simulations of CO_2 injection in selected zones to evaluate injection and monitoring strategies have been completed.

Another series of simulations will be conducted during 2005 with CO_2 flooding data from core analysis.
- A substantial outreach effort has been undertaken, including a several presentations to non-governmental organizations, scientific community, and other stakeholders.
- The regional geologic characterization effort has been expanded to include data and sample collection in two deep wells in southeastern Ohio in collaboration with the oil and gas industry.
- A draft site characterization report is substantially complete.

Based on the analysis, several major conclusions can be made. It has been established that there is excellent containment potential in this area. There is substantial heterogeneity in the storage potential in the region. The field tests and reservoir simulations show that the Rose Run Sandstone can store large amounts of CO_2. In addition, there are zones of potentially very high injection capacity in the carbonate rocks below Rose Run Sandstone. However, continuity of these zones needs to be established. The region is also amenable to enhanced injectivity through reservoir stimulation. Overall, it appears that geologic sequestration in this region can provide a major option to mitigate greenhouse emission concerns.

11. PLANS FOR COMING YEAR:

All the major activities of the initial site assessment phase have been completed and the site characterization report is being finalized. During 2005 the major activity related to the OCDO funded project will be to complete and submit the site characterization report. At the same time, Battelle is working with DOE and other project sponsors to continue the project into the next series of activities. The major activities planned for 2005 include evaluation of options and designs for CO_2 supply, preparation of permit documents for potential future injection and monitoring phases, continued stakeholder outreach, and continued regional geologic exploration. Any final decisions on the actual injection phase will be made by the project sponsors after the completion of design feasibility assessment.

12. HIGHLIGHTS/ACCOMPLISHMENTS:

During 2003 and 2004 substantial progress has been made in meeting all of the objectives of the project. The Ohio River Valley CO_2 project is being run in a stepwise manner and can be broadly broken into three phases – site assessment, design and permitting, and injection and monitoring. The initial site-assessment phase has been completed. A foundation has been laid to evaluate the injection scenarios. A partial description of the major activities and significant achievements of this effort includes:

- Prior to the start of the field effort, an extensive evaluation of the pre-existing geologic information for the study region was conducted to prepare a prognosis for the conditions likely to be encountered at the site.

This assessment was conducted in collaboration with the geological surveys of Ohio and West Virginia, and also included input from regional experts with decades of experience in Ohio Valley region. This resulted in a detailed report on the geologic characteristics that were likely to be encountered in the deeper formations in the study area.

- A detailed communication plan was prepared and Battelle, AEP, and DOE undertook a coordinated communication effort at local, regional, and national levels, prior to the project announcement by the Secretary of Energy. This stakeholder effort has continued throughout the project. The stakeholder effort also has attracted extensive positive media coverage of the project as well as for the carbon sequestration technology. These efforts have laid a strong foundation for the future phases by keeping key stakeholders fully informed of the project activities and findings and winning their trust.
- A seismic survey was conducted at and near the project site. Besides providing an assessment of geologic continuity in the area, the survey results have been used to evaluate the potential for seismic monitoring of injected CO_2 in the geologic environment typical of the deep basins in the Ohio River Valley region. Most importantly, the survey and the data analysis have demonstrated the real-life issues associated with conducting monitoring at active industrial facilities, such as finding the effect of plant noise on seismic data.
- The cornerstone of the project has been the drilling of a 9,200-ft deep borehole and the performance of borehole logging, hydraulic testing, fluid sampling, and core analysis to determine the characteristics of potential injection and containment zones. Most importantly, by conducting this effort at an active power plant, a number of practical regulatory, logistical, and safety issues have been identified and addressed.
- In addition to evaluating the feasibility of injection in previously identified zones, new potential injection zones have been identified. If proven to be geologically continuous, these zones can significantly enhance injection potential estimates for this region. The continuity and integrity of the caprocks also has been established.
- The core samples and borehole data have been shared with a number of organizations for advanced analysis and collaborative work. These include the NETL's Science and Technology group, BP's reservoir analysis laboratory, Stanford's Global Climate and Energy Program, Geological surveys in Ohio, West Virginia, and Kentucky, and many others. This extensive network of collaboration has vastly increased the scientific breadth of the program by bringing some of the best scientific expertise into the program.
- Realizing the need for obtaining crucial data from the deep subsurface while being mindful of the cost of such data collection, Battelle has built a truly unique, first-of-a-kind collaboration with oil and gas exploration companies in the region to obtain additional samples and data from wells being drilled in the region.

- Through this field research project, STOMP-CO_2, a state of the art reservoir simulator with parallel processing capability, has been developed at no cost to the current project. This simulator is being used at PNNL with some of the most powerful computers in the world to simulate the injection, monitoring, and risk assessment scenarios based on data collected under the Ohio River Valley CO_2 storage project.
- The fieldwork done under the current project is the only example of a CO_2 storage potential assessment at an operational power plant, with an opportunity to move into an injection phase that will test a variety of real life deployment issues for the first time.
- More than $500,000 has been subcontracted to support small and disadvantaged businesses in the Appalachian Basin region.

13. ARTICLES/PRESENTATIONS:

During 2003 and 2004, the project's status and interim findings were presented at several meetings and workshops, including many invited presentations. These included:

- American Association for Advancement of Sciences, February 2003
- Oak Ridge National Laboratory, February 2003
- Second National Conference on Carbon Sequestration, May 2003
- The Air & Waste Management Association conference, June 2003
- DOE Carbon Sequestration Program Review, June 2003
- Carbon Capture Project SMV Group workshop, September 2003
- Pittsburgh Coal Conference, September 2003
- American Geophysical Union Fall meeting, December 2003
- U.S. EPA workshop on CO_2 sequestration, February 2004
- Stanford University Global Climate and Energy Program (GCEP), April 2004
- Third National Conference on Carbon Sequestration, May 2004
- Battelle Environmental Remediation Conference, June 2004
- Presentations at NETL project review meetings, July 2004
- Project update to OAQDA and OCDO, July 2004
- Sixth International Conference on Greenhouse Gas Control Technologies September 2004 – one peer-reviewed oral presentation and four poster presentations on various aspects of the project
- Presentation at U.S.-Norway school on CO_2 sequestration, October 2004
- Presentation at the CO_2 monitoring network workshop held by IEA, EPRI, BP, November 2004
- OCDO/OAQDA Air Quality Symposium, November 2004