Lawrence Berkeley National Laboratory
Earth Sciences Division 90-1116
1 Cyclotron Rd.
Berkeley CA 94720
USA

CO_2 Capture Project

Technical Report

Health, Safety, and Environmental Risk Assessment for Leakage of CO_2 from Deep Geologic Storage Sites

January 10, 2003

Prepared by LBNL, on behalf of the CCP JIP

Seepage and Leakge Risk Assessment

CO_2 Seepage Risk Assessment

Description

LBNL researchers have long experience in Health, Safety, and Environmental (HSE) risk assessment for environmental pollutants. In the project, we will develop a coupled modeling framework for HSE risk assessment for geologic sequestration of CO_2. The framework will couple the following (i) geologic description of the reservoir, caprock and shallower formations, (ii) simulation of subsurface CO_2 migration, (iii) CO_2 dispersion over the ground surface and into buildings, (iv) exposures to human and ecological receptors, and (v) risk characterization. The framework can be used to assess the risks to plants, humans, and other animals of various leakage and seepage scenarios. The basis for the risk assessment is a detailed prediction of CO_2 concentration in space and time in both the subaerial and subsurface environments. Risk assessment of this type would normally be carried out prior to sequestration project development, although it could also be used to assess risks from known leakage from an operating storage reservoir. This framework will be demonstrated in this project through its application to the potential use of an onshore natural gas reservoir for carbon sequestration. No products will be manufactured or commercialized. None of the information used or developed in this project is confidential.

Process Flow Diagram

Risk assessment is fundamental to public acceptance and ultimate deployment of geologic carbon sequestration. Risk assessment is based on the ability to predict accurately CO2 concentrations likely to impact plants, humans, and other animals.

Work scope

In this project, we are investigating how CO2 is transported through the geologic subsurface from the target formation along potential leakage paths. During the leakage process, significant attenuation due to secondary hydrodynamic trapping, solubility trapping, and dispersion is expected. When CO2 reaches the shallow subsurface and seeps out from the ground, further dispersion will occur. We are investigating through numerical simulation the transport and dispersion processes associated with CO2 leakage, seepage, and atmospheric dispersion. The results of these analyses will feed into the risk assessment framework development and application. All times below are in months from project initiation on April 4, 2002.

3 Months (LBNL)

Task 1. Report on modeled surface leakage rates for a range of scenarios for CO_2 sequestration in geologic formations. Oldenburg et al. (2002a)

Task 2. Interim report describing the requirements and design for the coupled model for HSE risk assessment. Oldenburg et al. (2002b)

7 Months (LBNL)

Task 3. Report on atmospheric dispersion of CO_2 from leakage scenarios provided in Task 1.

13.5 Months (LBNL)

Task 4. Report on the coupled model, including methodology, structure and validation studies.

20 Months (LBNL)

Task 5. Report on case studies that use the coupled model for HSE risk assessment.

21 Months (LBNL)

Task 6. Final report summarizing all aspects of the HSE risk assessment using coupled subsurface/atmospheric models.

Stage Gate Criteria

Completion of deliverables demonstrates that the project is moving forward successfully.

Proof of Concept

Proof of concept for this project will be the defensible application of the methods as reported in our Task 5 and Task 6 reports.

Links

We are simultaneously developing simulation capabilities under an internally funded project. These new capabilities are used in this current BP-DOE CRADA project. This project is not directly dependent on any projects outside of LBNL, although we are currently in discussion with the SAMCARDS team at TNO to which we may be contributing results and capabilities in the coming year.

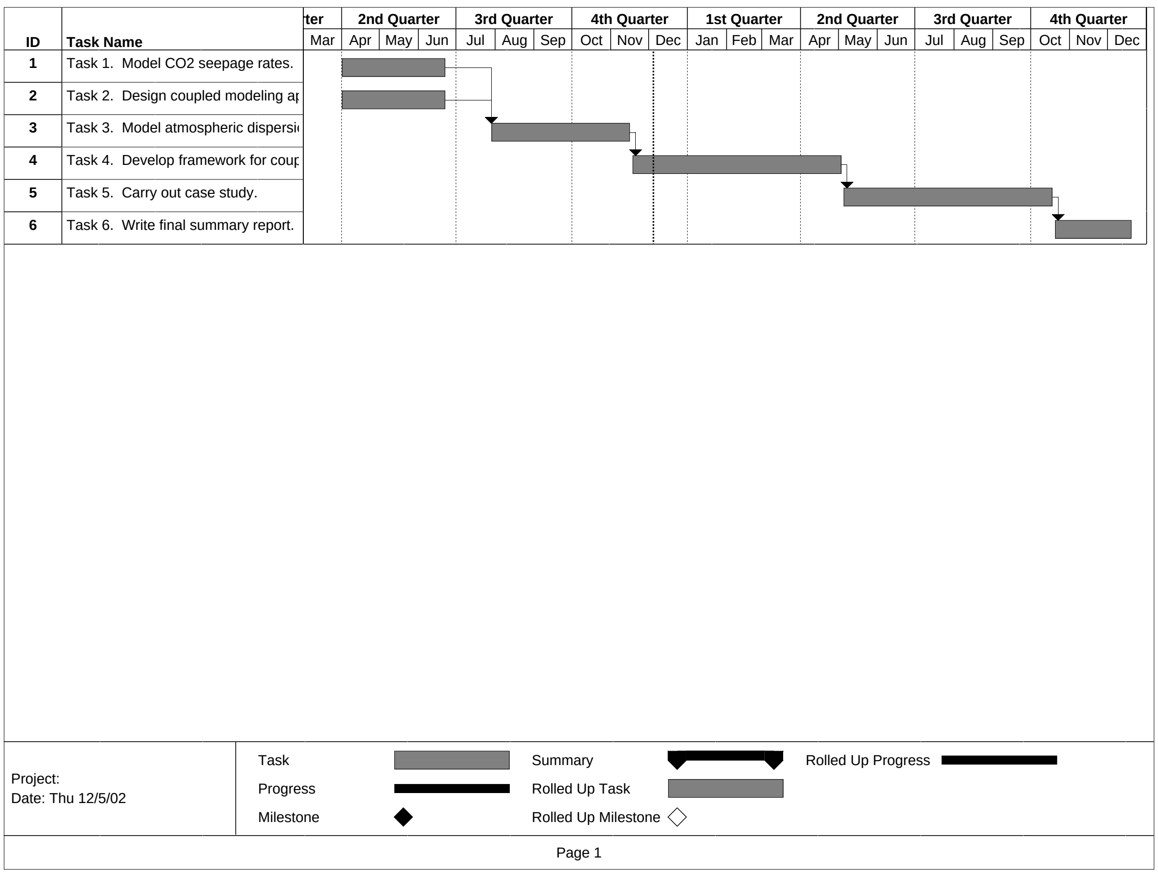
Cost Abatement Potential

We have not considered cost abatement.

Risks

Schedule

We foresee no difficulty in meeting the Task 4, 5, and 6 project deliverable deadlines within 2 weeks of the due dates. Below is a Gantt chart for the project.



Budget

The details of the project scope are currently being reassessed in light of the recent $50k budget reduction.

Technical

We are not considering cost abatement.

Highlights this month

We completed simulations of leakage and seepage with barometric pumping (i.e., variable surface pressure boundary condition). We observed in the simulations that barometric pumping can create higher seepage fluxes and higher near-surface CO2 concentrations during periods of low pressure. However, these trends are reversed during periods of high barometric pressure. Thus in a time-averaged sense, barometric pumping has a negligible effect on seepage and near-surface CO2 concentrations.

We finalized our manuscript on seepage and leakage in preparation for review under the terms of the contract.

We met with Toon Leijnse (TNO) at the Fall Meeting of the American Geophysical Union to discuss our projects and how LBNL and TNO can collaborate on risk assessment research. We sent electronic copies of all of our report deliverables to Dr. Leijnse.

Reports, Publications & Presentations to date

Oldenburg, C.M., A.J.A. Unger, R.P. Hepple, and P.D. Jordan, On Leakage and Seepage from Geologic Carbon Sequestration Sites, Lawrence Berkeley National Laboratory Report *LBNL-51130*, July 2002a.

Oldenburg, C.M., T.E. McKone, R.P. Hepple, and A.J.A. Unger, Health Risks from Leakage and Seepage of CO_2 Sequestered in the Subsurface: Requirements and Design of a Coupled Model for Risk Assessment, Lawrence Berkeley National Laboratory Report *LBNL-51131*, July 2002b.

Oldenburg, C.M., A.J.A. Unger, and R.P. Hepple, On Atmospheric Dispersion of CO2 Seepage from Geologic Carbon Sequestration Sites, Lawrence Berkeley National Laboratory Report *LBNL-51734*, November 2002.

Oldenburg, C.M., and A.J.A. Unger, On leakage and seepage from geologic carbon sequestration sites: unsaturated zone attenuation, in prep. for submission to Vadose Zone Journal.

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Competitor	Current Share	Share in 3 Yrs.
Largest competitor	50%	30%
Second largest competitor	25%	20%
Third largest competitor	15%	12%

Table. Projected Growth of Competitors.

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