LA-UR-12-25507
Approved for public release; distribution is unlimited.

Title: Quarterly Report for LANL Activities: FY12-Q3 National Risk Assessment Partnership (NRAP): Industrial Carbon Capture Program

Author(s): Pawar, Rajesh J.

Intended for: Report

Quarterly Report for LANL Activities: FY12-Q3

National Risk Assessment Partnership (NRAP): Industrial Carbon Capture Program

Report Date: October 12, 2012

Report Period: Jul – Aug 2012

WORK PERFORMED UNDER AGREEMENT

FWP FE-102-002-FY10

SUBMITTED BY

Los Alamos National Laboratory
P.O. 1663
Los Alamos, NM 87545

PRINCIPAL INVESTIGATOR

Rajesh Pawar

Contributors:

Bill Carey, Elizabeth Keating, Dennis Newell

PROGRAM MANAGER

Melissa Fox

SUBMITTED TO

U. S. Department of Energy
National Energy Technology Laboratory

Executive Summary:

This report summarizes progress of LANL activities related to the tasks performed under the LANL FWP FE102-002-FY10, National Risk Assessment Partnership (NRAP): Industrial Carbon Capture Program. This FWP is funded through the American Recovery and Reinvestment Act (ARRA). Overall, the NRAP activities are focused on understanding and evaluating risks associated with large-scale injection and long-term storage of CO_2 in deep geological formations. One of the primary risks during large-scale injection is due to changes in geomechanical stresses to the storage reservoir, to the caprock/seals and to the wellbores. These changes may have the potential to cause CO_2 and brine leakage and geochemical impacts to the groundwater systems. While the importance of these stresses is well recognized, there have been relatively few quantitative studies (laboratory, field or theoretical) of geomechanical processes in sequestration systems. In addition, there are no integrated studies that allow evaluation of risks to groundwater quality in the context of CO_2 injection-induced stresses. The work performed under this project is focused on better understanding these effects. LANL approach will develop laboratory and computational tools to understand the impact of CO_2-induced mechanical stress by creating a geomechanical test bed using inputs from laboratory experiments, field data, and conceptual approaches. The Geomechanical Test Bed will be used for conducting sensitivity and scenario analyses of the impacts of CO_2 injection. The specific types of questions will relate to fault stimulation and fracture inducing stress on caprock, changes in wellbore leakage due to evolution of stress in the reservoir and caprock, and the potential for induced seismicity. In addition, the Geomechanical Test Bed will be used to investigate the coupling of stress-induced leakage pathways with impacts on groundwater quality.

LANL activities are performed under two tasks: 1) develop laboratory and computational tools to understand CO_2-induced mechanical impacts and 2) use natural analog sites to determine potential groundwater impacts. We are using the Springerville-St. John Dome as a field site for collecting field data on CO_2 migration through faults and groundwater impacts as well as developing and validating computational models.

During the FY12 fourth quarter we received the tri-axial core-holder from New England Research Company (NERC). We have completed the construction of the experimental set up for performing coupled flow-stress experiments. We will be completing first set of flow through experiments in October.

Progress:

Task 1 Develop laboratory and computational tools to understand CO_2-induced mechanical impacts (Task Leads: Bill Carey, George Zyvoloski):

During the fourth quarter a priority task was completing the construction of the triaxial core flood system. The system is constructed on three mobile carts which allow for reconfiguration of the system and transportation and installation of the system at neutron or x-ray tomography facilities. Final components and core holders were delivered to LANL and integrated into the flow system. Figure 1-4 show the pictures of various parts of the coreflooding experimental system. Currently we are

Figure 1. Overview of triaxial coreflood system. The system is portable to allow experiments at tomography facilities and is constructed on three separate, mobile carts. The middle cart contains the triaxial coreholder, pumps for confining pressure and axial load, pressure transducers, and fluid sampling. The right cart contains the brine delivery system, which includes two pumps and an accumulator for delivering continuous brine flow. The left cart contains the CO_2 delivery system, which includes two pumps, an accumulator, and a fluid sampling port. On all three carts, the pumps are located on the lower shelf.

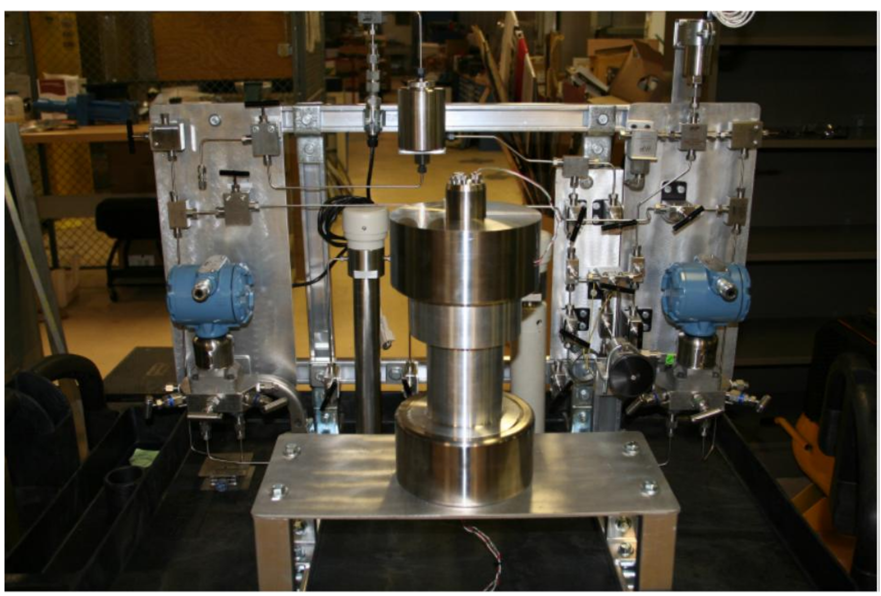

Figure 2. Close-up of the coreflood cart (central cart in Figure 1) showing the triaxial coreholder in the foreground (multi-level cylinder) and pressure transducers and sampling loop in the background.

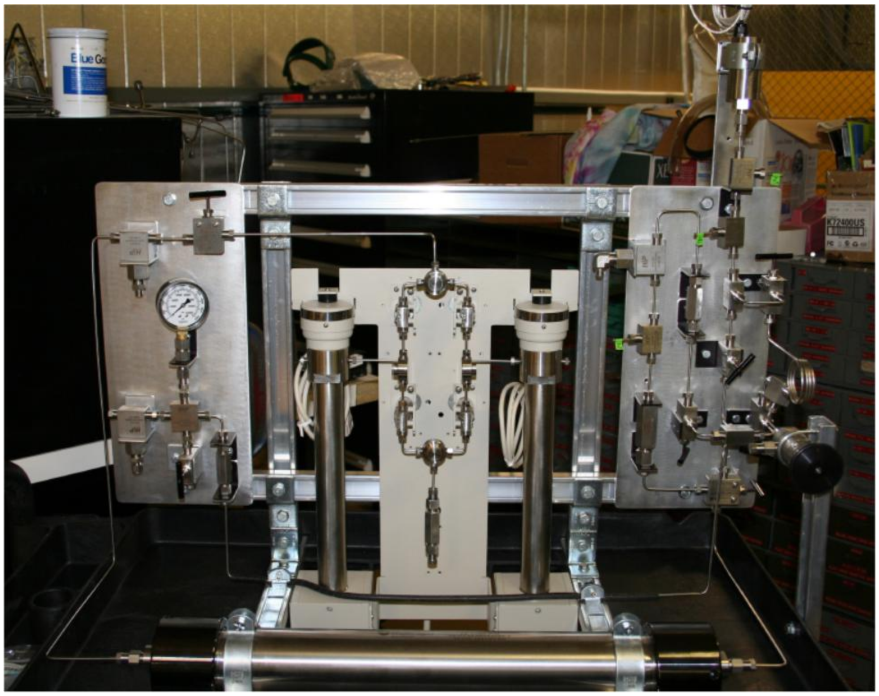

Figure 3. Close-up of brine fluid delivery cart (right-hand cart in Figure 1) showing the Isco pump heads, accumulators, tubing and fittings.

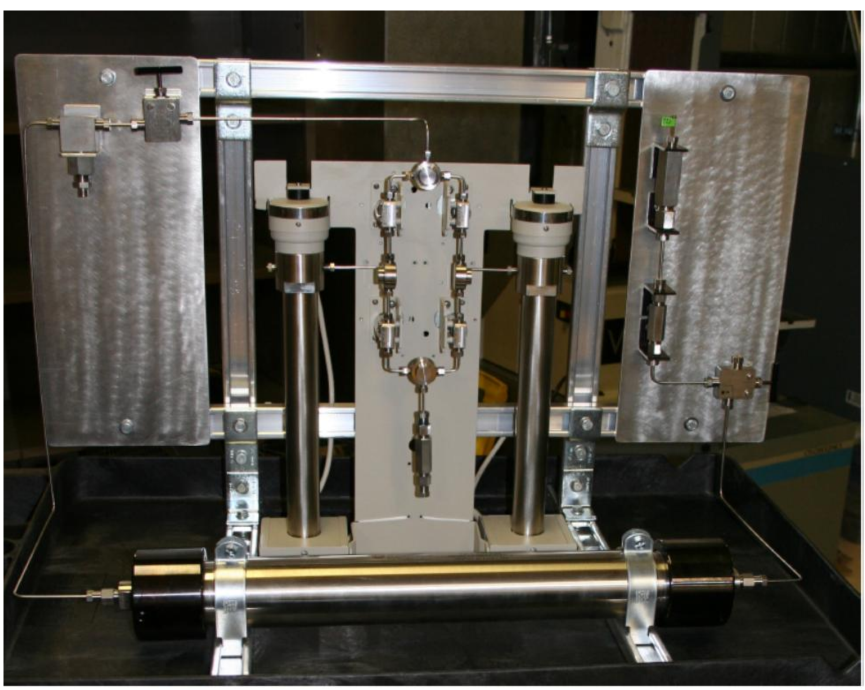

Figure 4. Close-up of CO_2 delivery cart (left-hand cart in Figure 1) showing Isco pump heads, accumulator, pressure gauges, sampling loop, tubing and fittings.

performing pressure safety tests to approve the system for use. In preparation for triaxial coreflood experiments, target core samples from Springerville-St. John dome were selected for sub-coring to produce 1 in. X 2.5 in. samples for triaxial testing. Rock-types chosen for testing include the likely caprocks (tight siltstones and anhydrite beds) and the reservoir rocks (sandstones and limestones). Samples were sub-cored parallel and perpendicular to bedding, and several samples were chosen that include pre-existing fractures. The coreflooding experiments will start as soon as the pressure safety approval is received.

Milestones and Status:

1.1: Acquire, design and construct triaxial core flood system (Completion Date: 7/31/2012)

Status: completed 7/31/2012

1.2: Complete geomechanical flow-through experiments: caprock (Completion Date: 9/30/2012)

Status: Expected to be completed on 10/31/2012.

1.3: Complete geomechanical flow-through experiments: wellbore materials (Completion Date: 9/30/2013)

Status: not started.

2.1: Complete geomechanical simulations (Completion Date: 9/30/2013)

Status: Initiated.

2.2: Create geomechanical test bed (Completion Date: 6/30/2012)

Status: Initiated

2.3: Sensitivity and scenario analysis (Completion Date: 9/30/2013)

Status: not started.

3.1: Baseline predictive reactive-transport model for natural analog site (Completion Date: 9/30/2012)

Status: Initiated.

3.2: Groundwater chemistry observations at a natural analog site, compared to reactive-transport (Completion Date: 9/30/2012)

Status: initiated.

3.3: Assessment of predictive capability of reactive-transport models and value of information assessment (Completion Date: 9/30/2013)

Status: not started.