



Plains CO<sub>2</sub> Reduction (PCOR) Partnership  
Energy & Environmental Research Center (EERC)

## Plains CO<sub>2</sub> Reduction (PCOR) Partnership Monthly Update September 1–30, 2014

### PHASE III ACTIVITIES

#### Task 1 – Regional Characterization (Wesley D. Peck)

##### Highlights

- Hosted a meeting on September 15, 2014, in Denver, Colorado, with the Petroleum Technology Research Centre (PTRC) in conjunction with the Plains CO<sub>2</sub> Reduction (PCOR) Partnership Annual Membership Meeting.
- Attended the PCOR Partnership Annual Membership Meeting in Denver, Colorado, September 15–17, 2014.
- Continued work on the Bell Creek project atlas pages for inclusion in the upcoming U.S. Department of Energy National Energy Technology Laboratory (DOE NETL) atlas (due October 17 to DOE).
- Continued review of carbon dioxide (CO<sub>2</sub>) source information for the annual update.
- Continued working with programming to improve the online geographic information system (GIS) map.
- Continued updates to the partners-only Web site, including prior-approved Bell Creek information.
- Updated North Dakota and Montana Petra database with the latest general well information from each state's online resource, including adding 61 new North Dakota wells and 18 new Montana wells.
- Uploaded papers and continued work on posters for the 12th International Conference on Greenhouse Gas Control Technologies (GHGT-12) to be held in October in Austin, Texas.
- Submitted an update to the review source attributes report (Deliverable [D]1) on September 30, 2014.
- Submitted the third target area D7 on September 30, 2014.
- Continued work on several value-added reports, including the following:
  - Reviewed and modified the draft regional characterization report summarizing all past and present efforts.
  - Continued work on the report summarizing methods of original oil in place and CO<sub>2</sub> storage calculations.
  - Continued efforts on the Cedar Creek Anticline white paper, including creation of production charts from data to populate the report.
- With regard to the **Aquistore core work** (12 samples):
  - Scanning electron microscopy (SEM) results are pending.
  - Relative permeability on the second sample has been restarted, with 100% brine run through the sample.

- Began preparation of the data sheets.
- Continued work on clay analysis and quantitative x-ray diffraction (XRD) analyses.
- Continued relative permeability to CO<sub>2</sub> and brine analyses.
- With regard to the **Aquistore** project's static modeling and dynamic predictive simulations effort:
  - Scheduled a WebEx with PTRC (including Science and Engineering Research Committee) for October 2, 2014, to discuss next steps with regard to the Aquistore project.
  - Continued work on the new simulation scenarios to investigate when the pressure front reaches the monitoring well.
  - Submitted D93 (modeling and simulation update) on September 30, 2014.
  - Continued work on facies model.
  - Continued running base-case simulations and preparing models for simulation.

## **Task 2 – Public Outreach and Education (Daniel J. Daly)**

### Highlights

- Interviewed Juho Lipponen, head of the Carbon Capture and Storage (CCS) Unit at the International Energy Agency, in Paris, France, for the coal documentary. In addition, captured footage in Baden-Baden, Germany.
- Continued efforts to expand the type and presentation of statistics for overall past outreach activities and for planning.
- Continued to revise three draft Phase II project fact sheets including meetings with project personnel to discuss content, with a focus on Terrestrial and McGregor projects.
- Finalized arrangements with interviewees for the European filming trip (for D22).
- Met with representatives of the Lignite Energy Council (LEC) to discuss additional contacts and site visits while in Europe.
- Corresponded by e-mail with teachers in the region regarding potential participation in the Carbon Challenge coordinated by SaskPower as part of activities related to the Boundary Dam carbon capture facility commissioning.
- Provided written and oral comments to the Regional Carbon Sequestration Partnerships (RCSP) Outreach Working Group (OWG) regarding the draft OWG paper that will be presented at GHGT-12.
- Attended the North Dakota Library Association (NDLA) 2014 Annual Conference in Bismarck, North Dakota, in mid-September and distributed the new public outreach poster and other materials.
- Attended the PCOR Partnership Annual Membership Meeting in Denver, Colorado, September 15–17, 2014.
- Continued efforts with regard to the public Web site ([www.undeerc.org/pcor](http://www.undeerc.org/pcor)), including the following:
  - Continued ongoing identification and repair of broken links.
  - Worked on addition of new and updated fact sheets to the public Web site.
- Continued collaborative efforts with Prairie Public Broadcasting (PPB), including the following:
  - Finalized agreements with interviewees for the Europe trip for the D22 documentary (Coal and the Modern Age) scheduled for September 19–30, 2014.

- Traveled to France, Germany, and Denmark for the European filming trip September 19–30, 2014.

### **Task 3 – Permitting and NEPA (National Environmental Policy Act) Compliance (Lisa S. Botnen)**

#### Highlights

- Continued review of the U.S. Environmental Protection Agency-proposed rule for carbon emissions from existing stationary sources.
- Attended the PCOR Partnership Annual Membership Meeting in Denver, Colorado, September 15–17, 2014.

### **Task 4 – Site Characterization and Modeling (James A. Sorensen)**

#### Highlights

- **Bell Creek** test site activities included the following:
  - Continued working with the preliminary facies modeling.
  - Created a series of Bell Creek seismic (planned and completed) outline maps for in-house use.
  - Worked on passive microseismic monitoring, including the borehole array and recording system provided by Sigma<sup>3</sup>—daily operational checks are now performed by the EERC—and found/tested a utility application to view SEG-D field records (SegDSee) that will allow a verification check of data records after loading to the server.
  - Continued work on picking horizons for the underburden formations of the reservoir using seismic data.
  - Continued literature review on the process of building a seismic-driven 3-D geomechanical model using the 1-D mechanical earth model (MEM) and 3-D seismic AVO (amplitude variations with offset) inversion and estimating stress and geomechanical properties using 3-D seismic data.
  - Continued working on the 3-D MEM including creating synthetic logs for selected wells and researching the potential to include PNL (pulsed-neutron logging).
  - Submitted the PNL poster for the upcoming GHGT-12 conference.
  - Worked on incorporating lab-generated data into Techlog to supplement data currently in the 3-D model. Worked on the 3-D surface seismic baseline survey, including the geomechanical model, maps (including creating maps of 11.5-square-mile monitor survey), and interpretations.
  - Continued preparing for the geomechanical simulations.
  - Continued work on the Bell Creek characterization.
  - Threshold entry pressure work by Core Labs is ongoing.
  - Applied Geology Laboratory activities included the following:
    - ♦ With regard to the 33-14R core (collected April 2013):
      - Continued fine-tuning the thin-section descriptions and XRD data.
      - Continued permeability-to-air testing (three samples remain).
    - ♦ With regard to the 56-14R full-core plugs (collected March 2013):
      - Porosity measurements were completed, and perm-to-air measurements were begun.

### **Task 5 – Well Drilling and Completion (John A. Hamling)**

- This task ended in Quarter 3 – Budget Period 4 (BP4), Year 7 (June 2014).

### **Task 6 – Infrastructure Development (Melanie D. Jensen)**

#### Highlights

- Continued work on a journal article (about the attenuation of variable CO<sub>2</sub> sources for use in enhanced oil recovery [EOR]) for submission to *Energy & Environmental Science* ([www.rsc.org/publishing/journals/ee/about.asp](http://www.rsc.org/publishing/journals/ee/about.asp)).
- Continued to update technologies for the CO<sub>2</sub> capture technologies update overview.
- Attended the PCOR Partnership Annual Membership Meeting in Denver, Colorado, September 15–17, 2014.

### **Task 7 – CO<sub>2</sub> Procurement (John A. Harju)**

- This task ended in Quarter 4 – BP4, Year 6 (September 2013).

### **Task 8 – Transportation and Injection Operations (Melanie D. Jensen)**

#### Highlights

- Researched the effects of different impurities in CO<sub>2</sub> from anthropogenic sources on pipeline operation during start-up and shutdown and at transient conditions. The effects of impurities on operability of injection site infrastructure were reviewed. The effects of CO<sub>2</sub> stream variability on pipeline and injection field infrastructure were also studied.
- Attended the PCOR Partnership Annual Membership Meeting in Denver, Colorado, September 15–17, 2014.

### **Task 9 – Operational Monitoring and Modeling (Charles D. Gorecki)**

#### Highlights

- Staff attended a 2-day training workshop (September 22–23, 2014) at the Energy & Environmental Research Center (EERC) held by Outsource Petrophysics, covering the basics of petrophysical analysis (used in both modeling and laboratory activities).
- Began work with Outsource Petrophysics on an SPWLA (Society of Petrophysicists and Well Log Analysts) abstract on nuclear magnetic resonance (NMR) log and thin-section work.
- Attended the PCOR Partnership Annual Membership Meeting in Denver, Colorado, September 15–17, 2014.
- **Bell Creek** injection-phase site activities included the following:
  - Created a new Bell Creek production/injection map for new data through July 2014.
  - With regard to the near-surface monitoring, verification, and accounting (MVA) testing, collected, archived, and verified the remaining FY14 lab gas chromatography confirmatory soil gas composition analyses, including December 2013 (13 samples), April 2014 (nine samples), and June 2014 (16 samples).

- Collected and archived the July 30, 2014, purchase and recycle stream Isotech gas composition and isotope data.
- Traveled to Bell Creek (September 18–25, 2014) to conduct the near-surface MVA annual full-field repeat sampling event.
- Traveled to Bell Creek (September 21–25, 2014) to download data from the MOREVision and Qorex units.
- Attended the North Dakota Petroleum Council Annual Meeting held in Dickinson, North Dakota.
- Cumulative CO<sub>2</sub> injection is 1,247,174 metric tons through August 31, 2014 (Table 1).
- Completed 19 PNL monitor logs within and surrounding the Phase 1 development area to monitor for vertical CO<sub>2</sub> migration in the near-wellbore environment and changes in water, oil, and gas saturations to evaluate conformance and storage efficiency.
  - ♦ Completed initial quality control (QC) and quick analysis of sigma logs in 19 wells; detailed analysis and processing is in progress.
- Continued tuning the Phase 2 history-matching model.
- Worked on the history match of CO<sub>2</sub> injection in the Phase 1 area.
- Worked on reviewing the microseismic interpretation method and software.
- Worked with the in-house geophysicists on the 3-D seismic data, specifically on fracture identification.
- Continued building the updated facies model for the fieldwide model.
- Continued literature review for CO<sub>2</sub> EOR strategies.
- Worked on preparing data for the Phase 2 simulations, including cutting the geomodel.
- Continued reservoir surveillance and analysis of continuous permanent downhole monitoring (PDM) data in the 05-06 OW well.
- Continued injection-phase sampling work, including the following:
  - ♦ Completed the near-surface MVA annual full-field repeat sampling event on September 25, 2014, including:
    - Approximately 400 total soil gas bag samples.
    - 27 total water samples.
  - ♦ Analysis is under way.
  - ♦ Continued planning construction of the SQL database to house and access near-surface monitoring data.

**Table 1. Bell Creek CO<sub>2</sub> Injection Totals for August 2014 (cumulative totals May 2013 to August 2014)**

	August 2014 Injection
Total, Mscf	2,384,170
Total, U.S. tons*	136,371
Total, metric tons*	123,834
Cumulative Total, Mscf <sup>+</sup>	24,011,846
Cumulative Total, U.S. tons* <sup>+</sup>	1,373,440
Cumulative Total, metric tons* <sup>+</sup>	1,247,174

Source: Montana Board of Oil and Gas [MBOG] database.

\* There is an approximately 2–3-month lag in posting of injection/production volumes to the MBOG database. This was calculated utilizing a conversion of 17.483 Mscf/U.S. ton and 19.253 Mscf/metric ton.

<sup>+</sup> Cumulative totals are for the period from May 2013 to the month listed.

- ◆ Continued evaluation of creating an interactive map product to facilitate improved access and interpretation for team.
- **Fort Nelson** site activities included the following:
- Submitted the draft Best Practices Manual – Fort Nelson Feasibility Study (D100).

#### **Task 10 – Site Closure (to be announced [TBA])**

- This task is anticipated to be initiated in Quarter 1 – BP5, Year 9 (October 2015).

#### **Task 11 – Postinjection Monitoring and Modeling (TBA)**

- This task is anticipated to be initiated in Quarter 1 – BP5, Year 9 (October 2015).

#### **Task 12 – Project Assessment (Katherine K. Anagnost)**

##### Highlights

- Nothing to note at this time.

#### **Task 13 – Project Management (Charles D. Gorecki)**

##### Highlights

- Held a task leader meeting September 3, 2014. Topics discussed included discussion on proposed best practice manuals (BPMs), the upcoming annual meeting, GHGT-12 papers (upload date September 12), upcoming deliverables and conferences, as well as updates from task leaders present.
- Attended and presented at the University of South Carolina Energy Leadership Institute's Cradle to Grave: CO<sub>2</sub> Opportunities and Challenges on September 11, 2014, in Columbia, South Carolina.
- Hosted the 2014 PCOR Partnership Annual Membership Meeting September 16 and 17, 2014, at the Embassy Suites in downtown Denver, Colorado. Held the following side meetings in conjunction with the PCOR Annual Membership Meeting:
  - Technical Advisory Board (TAB) side meeting.
  - PTRC Aquistore meeting.
- Began making plans to attend the upcoming Carbon Sequestration Leadership Forum (CSLF) 2014 Annual Meeting (October 27–30) in Warsaw, Poland.
- In conjunction with the University of North Dakota College of Engineering and Mines, the EERC participated in Energy Research Day on September 4 and displayed a PCOR Partnership booth, posters, fact sheets, atlases, and DVDs.
- Received a request from DOE on September 2 to provide updated information tracking progress in the development of technologies that will assist in CCS Development for the CSLF Technology Roadmap (due September 19).
  - Held an internal meeting to discuss progress reporting and how to proceed.
- Submitted the August monthly update.
- Uploaded GHGT-12 papers with the following titles:
  - Evaluation of Large-Scale Carbon Dioxide Storage Potential in the Basal Saline System in the Alberta and Williston Basins in North America

- Characterization and Time-Lapse Monitoring Utilizing Pulsed-Neutron Well Logging at an Incidental CO<sub>2</sub> Storage Demonstration
- Application of Canadian Standards Association Guidelines for Geologic Storage of CO<sub>2</sub> Toward the Development of a Monitoring, Verification, and Accounting Plan for a Potential CCS Project at Fort Nelson, British Columbia, Canada
- A Regional Wellbore Evaluation of the Basal Cambrian System
- Guidance for States and Provinces on Operational and Postoperational Liability in the Regulation of Carbon Geologic Storage
- The Nexus of Water and CCS: An RCSP (Regional Carbon Sequestration Partnership) Perspective
- A Workflow to Determine CO<sub>2</sub> Storage in Deep Saline Formations
- A Rapid Method for Determining CO<sub>2</sub>–Oil MMP and Visual Observations of CO<sub>2</sub>–Oil Interactions at Reservoir Conditions
- Model Development of the Aquistore CO<sub>2</sub> Storage Project
- Deliverables and milestones completed in September:
  - Task 1: D1 – Review of Source Attributes (update)
  - Task 1: D7 – Third Target Area Completed
  - Task 1: D93 – Geologic Modeling and Simulation Report for the Aquistore Project (update)
  - Task 9: D100 – Fort Nelson Carbon Capture and Storage Feasibility Study – A Best Practices Manual for Storage in a Deep Carbonate Saline Formation
  - Task 14: M23 – Monthly WWG Conference Call Held

#### **Task 14 – RCSP Water Working Group (WWG) Coordination (Ryan J. Klapperich)**

##### Highlights

- Uploaded the WWG paper for GHGT-12.
- Accepted invitation to present WWG poster as an oral presentation during the Water and CCS session.
- Continued work on the WWG presentation for GHGT-12.
- Made additional edits to the WWG fact sheet (D99) due October 31, 2014.
- Suggested edits to the WWG Web site (hosted by NETL), mostly focused on simplifying the text.
- Brainstormed about ideas for future work with WWG members.
- Held the monthly WWG conference call on September 30, 2014. Topics discussed focused on future products and collaborations for the WWG.
- Continued work on the latest fact sheet (D99, due October 31, 2014) focused on future protection of water resources.
- Attended the PCOR Partnership Annual Membership Meeting in Denver, Colorado, September 15–17, 2014.

#### **Task 15 – Further Characterization of the Zama Acid Gas EOR, CO<sub>2</sub> Storage, and Monitoring Project (Charles D. Gorecki)**

- This task ended in Quarter 2 – BP4, Year 7 (February 2014).

## **Task 16 – Characterization of the Basal Cambrian System (Wesley D. Peck)**

- This task ended in Quarter 2 – BP4, Year 7 (March 2014).

### **Travel/Meetings**

- September 9–12, 2014: Traveled to Columbia, South Carolina, to present at the University of South Carolina Energy Leadership Institute’s Cradle to Grave: CO<sub>2</sub> Opportunities and Challenges.
- September 14–18, 2014: Traveled to Denver, Colorado, to host the PCOR Partnership Annual Membership Meeting.
- September 17–19, 2014: Traveled to Bismarck, North Dakota, to attend the NDLA Annual Meeting and Exhibit.
- September 17–28, 2014: Traveled to Gillette, Wyoming, for sampling at Bell Creek oil fields.
- September 21–25, 2014: Traveled to Gillette, Wyoming, for site work at the Bell Creek oil fields.
- September 23–26, 2014: Traveled to Dickinson, North Dakota, to attend the NDPC Annual Meeting.

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