



## Plains CO<sub>2</sub> Reduction (PCOR) Partnership Monthly Update August 1–31, 2014

### PHASE III ACTIVITIES

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

##### Highlights

- Submitted a value-added report entitled “Broom Creek Formation Outline” on August 28, 2014.
- Continued review of carbon dioxide (CO<sub>2</sub>) source information for the annual update.
- Checked progress regarding proposed changes/solutions for the partners-only Decision Support System (DSS) site.
- Updated North Dakota and Montana Petra database with the latest general well information from each state’s online resource, including adding 91 new North Dakota wells and six new Montana wells and updated North Dakota production data used for reservoir calculations.
- Continued work on posters and papers for the 12th International Conference on Greenhouse Gas Control Technologies (GHGT-12) to be held in October in Austin, Texas.
- Continued work on the third target area (Deliverable [D]7, due September 2014), the Minnelusa Formation in Wyoming.
- Continued work on several value-added reports, including the following:
  - Continued information gathering and report drafting for a 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.
- With regard to the **Aquistore core work** (12 samples):
  - Worked 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:
  - Continued work on the new simulation scenarios to investigate when the pressure front reaches the monitoring well. This scenario was discussed during a conference call last month with the Petroleum Technology Research Centre (PTRC) Science and Engineering Research Committee (SERC).
  - Completed an update of P10, P50, and P90 models for the uncertainty-modeling portion of the simulation study. These simulations will be incorporated into D93, due 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

- 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.
- On August 21, 2014, participated in the monthly Outreach Working Group (OWG) conference call and provided feedback on the initial draft of the paper being prepared for presentation at GHGT-12.
- Continued an in-house review of outreach products using a standard, industry-accepted framework, with a focus on completing an inventory of products and review framework.
- Presented to the Lion's Club on August 20, 2014, in Grand Forks, North Dakota.
- Made plans to attend the North Dakota Library Association Meeting in Bismarck, North Dakota, in mid-September to distribute the new public outreach poster and other materials.
- Continued efforts with regard to the public Web site ([www.undeerc.org/pcor](http://www.undeerc.org/pcor)), including the following:
  - Performed a Web site check to ensure tracking of all PCOR Partnership Web items (Web pages, PDFs, and videos) was not affected by the upgrade.
  - Continued ongoing identification and repair of broken links.
- Continued collaborative efforts with Prairie Public Broadcasting (PPB), including the following:
  - Corresponded with potential interviewees and site locations for the Europe trip for the D22 documentary (Coal and the Modern Age) scheduled for September 19–30, 2014.
  - Held a call with personnel from the World Resources Institute to discuss locations and interviews for the upcoming China trip (estimated for spring 2015) for D22.
  - Booked flights for the European filming trip for September 19–30, 2014.

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

### Highlights

- Provided a review of carbon capture and storage (CCS) injection regulations and greenhouse gas reporting requirements to internal staff for use in various white papers and reports.
- Continued review of the U.S. Environmental Protection Agency-proposed rule for carbon emissions from existing stationary sources.
- Finalized the Interstate Oil and Gas Compact Commission (IOGCC) Operational and Postoperational Liability Report with DOE, and forwarded the final document to IOGCC for publication.

## **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.

- Worked on entering core data into the Petra project – a total of 138 wells are now in the project, with core data from Exxon, Colorado School of Mines, and the U.S. Geological Survey (USGS) (Denver).
- Worked 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 1-D and 3-D MEMs including using well log data to update the rock mechanical properties of the 1-D MEM and construct the 3-D MEM and adjusting zones, layering, and gridding to improve the accuracy of the property population of the 3-D MEM.
- Continued work on the pulsed-neutron logging (PNL) poster for the upcoming GHGT-12 conference.
- Continued preparing for the geomechanical simulations.
- Horizons for the Version 3 geologic model were picked from the 3-D seismic.
- Continued work on 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):
    - Fine-tuning the thin-section descriptions and XRD data.
    - Worked on scanning electron microscopy (SEM) analysis.
    - Permeability-to-air testing occurred the week of August 4, 2014.
  - ♦ With regard to the 56-14R full-core plugs (collected March 2013), worked continued.

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

- This task ended in Quarter 3 – 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)).
- Attended the DOE CO<sub>2</sub> Capture Technologies Conference July 29 – August 1 in Pittsburgh.
- Continued to update technologies for the CO<sub>2</sub> capture technologies update overview.
- Spoke with Dresser–Rand representative regarding the list of possible sites for a field demonstration of the SuperCompressor.

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

- This task ended in Quarter 4 – Budget Period (BP) 4, 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, 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.

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

### Highlights

- **Bell Creek** injection-phase site activities included the following:
  - Spoke with Denbury regarding the recently collected 2-D seismic line; they are seeing good results with the data. Also discussed planning for a potential repeat 3-D surface seismic survey.
  - Cumulative CO<sub>2</sub> injection is 1,123,341 metric tons through July 31, 2014 (Table 1).
  - With regard to the summer 2014 repeat PNL campaign: finalized evaluation and selection of wells for repeat PNLs, with a planned initiation date of July 21, 2014.
  - 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.
  - Held operations review meeting with Schlumberger in Denver to discuss ways to improve operational excellence during well log acquisition.
  - Continued tuning the Phase 2 history match model.
  - Submitted the executive summary for D66, Simulation Update, August 27, 2014.
  - Worked on the history match of CO<sub>2</sub> injection in the Phase 1 area.
  - Worked on reviewing 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.

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

	July 2014 Injection
Total, Mscf	2,424,888
Total, U.S. tons*	138,700
Total, metric tons*	125,949
Cumulative Total, Mscf <sup>+</sup>	21,627,676
Cumulative Total, U.S. tons* <sup>+</sup>	1,237,069
Cumulative Total, metric tons* <sup>+</sup>	1,123,341

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.

- 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 05-06 OW well.
- Continued injection-phase sampling work, including the following:
  - ◆ Continued to work on scheduling/preparation for the “full” Bell Creek sampling event (this activity is tentatively planned for the week of September 15 or 22).
  - ◆ Traveled to the Bell Creek site July 29 – August 1 for the July Bell Creek sampling event and completed the following:
    - Collected CO<sub>2</sub> purchase and recycle samples.
    - Collected Phase 1 oil samples.
    - Collected limited groundwater parameter samples.
    - Met with landowners.
    - Performed maintenance on EERC sites (field office, monitoring well, soil gas profile station locations)
  - ◆ Continued planning construction of the SQL database to house and access near-surface-monitoring data.
  - ◆ Continued evaluation of creating an interactive map product to facilitate improved access and interpretation for team.
- **Fort Nelson** site activities included the following:
  - Continued review of 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

- Attended and presented at the IEA Greenhouse Gas R&D Programme (IEAGHG) Combined Monitoring and Modelling Network Meeting on August 4–7, 2014, in Morgantown, West Virginia. Presentations included the following:
  - An oral presentation entitled “Modeling and Monitoring Associated with CO<sub>2</sub> Storage at the Bell Creek Field.”
  - Three posters: Zama, Basal Cambrian, and Aquistore.
- Attended and presented at the DOE Carbon Storage R&D Project Review Meeting held August 12–14, 2014, in Pittsburgh, Pennsylvania. Presentations included the following:

- An oral presentation entitled “Bell Creek Field Project” in the plenary session.
- Four posters: Basal Cambrian, Zama, Fort Nelson, and Aquistore.
- Attended the National Risk Assessment Partnership (NRAP) Stakeholders Meeting on August 14–15, 2014, in Pittsburgh, Pennsylvania.
  - Presented in an impromptu panel session discussing the monitoring, verification, and accounting (MVA) activities that are being conducted at Bell Creek.
- Reviewed draft minutes from the Technical Advisory Board (TAB) WebEx held June 27, 2014.
- Submitted the July monthly update.
- Continued work on 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
- Continued planning the 2014 PCOR Partnership Annual Membership Meeting scheduled for September 16 and 17, 2014, at the Embassy Suites in downtown Denver, Colorado, including the following:
  - Continued drafting the preliminary agenda.
  - Continued planning for the TAB side meeting.
  - Continued planning for the PTRC Aquistore meeting.
  - On August 5, sent e-mail blast regarding the availability of the preliminary agenda.
  - On August 19, sent e-mail blast regarding hotel room block cutoff date.
  - Continued preparation of presentations, posters, booth backdrops, and associated events.
- Submitted a value-added programmatic risk management plan update (including an updated Bell Creek risk assessment) on August 29, 2014.
- Deliverables and milestones completed in August:
  - Task 9: D66 – Bell Creek Test Site – Simulation Report (Update 3)

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

##### Highlights

- Revising the WWG paper for GHGT-12.
- Finalized the WWG poster for GHGT-12.

- Continued reviewing suggested revisions to the latest fact sheet (D99, due October 31, 2014) focused on future protection of water resources.
- Hosted the WWG Annual Meeting August 11, 2014, in conjunction with the 2014 Carbon Storage R&D Project Review Meeting in Pittsburgh, Pennsylvania, August 12–14, 2014. The RCSP OWG was invited to attend. Topics discussed included future activities for WWG and opportunities to partner with OWG.
- Reviewing the WWG Annual Meeting notes with the consultant to formulate next steps.

#### **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**

- July 28 – August 1, 2014: Traveled to Pittsburgh, Pennsylvania, to attend the 2014 CO<sub>2</sub> Capture Technology Meeting.
- July 29 – August 2, 2014: Traveled to Gillette, Wyoming, for site sampling work at the Bell Creek Station.
- August 3–8, 2014: Traveled to San Diego, California, to present at the 2014 SEG/SPE/AAPG/SPWLA/EAGE (Scientific Ecology Group, Inc. – Society of Petroleum Engineers–American Association of Petroleum Geologists–Society of Petrophysicists and Well Log Analysts–European Association of Geoscientists and Engineers) Summer Research Workshop.
- August 3–9, 2014: Traveled to Gillette, Wyoming, for site work at Bell Creek.
- August 4–7, 2014: Traveled to Morgantown, West Virginia, to present at the IEAGHG Combined Monitoring and Modelling Network Meeting.
- August 9–16, 2014: Traveled to Gillette, Wyoming, for site sampling work at the Bell Creek Station.
- August 10–17, 2014: Traveled to Pittsburgh, Pennsylvania to present at the 2014 Carbon Storage R&D Project Review Meeting, to host the WWG Annual Meeting, and to attend the NRAP Stakeholder’s Meeting.

#### **EERC DISCLAIMER**

LEGAL NOTICE: This research report was prepared by the EERC, an agency of the University of North Dakota, as an account of work sponsored by DOE NETL. Because of the research nature of the work performed, neither the EERC nor any of its employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed or represents that its use would not infringe privately owned rights. Reference herein to any specific

commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement or recommendation by the EERC.

## **DOE DISCLAIMER**

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government, nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

## **ACKNOWLEDGMENT**

This material is based upon work supported by DOE NETL under Award No. DE-FC26-05NT42592.

## **NDIC DISCLAIMER**

This report was prepared by the EERC pursuant to an agreement partially funded by the Industrial Commission of North Dakota, and neither the EERC nor any of its subcontractors nor NDIC nor any person acting on behalf of either:

- (A) Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or
- (B) Assumes any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this report.

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by NDIC. The views and opinions of authors expressed herein do not necessarily state or reflect those of the NDIC.