Plains CO_2 Reduction (PCOR) Partnership
Energy & Environmental Research Center (EERC)

Plains CO_2 Reduction (PCOR) Partnership Monthly Update
January 1–31, 2015

PHASE III ACTIVITIES

Task 1 – Regional Characterization (Wesley D. Peck)

Highlights

- Continued the update to the Plains CO_2 Reduction (PCOR) Partnership Atlas (5th Edition) due August 2015, with the hope that it could be finalized, printed, and ready for distribution at the 2015 Annual Membership Meeting.
- Submitted an abstract to the 14th Annual CCUS (Carbon Capture, Utilization, and Storage) Conference (CCUS-14) (April 28 – May 1, 2015) entitled "Geologic Modeling and Simulation at the Aquistore Site: A Guide to MVA (monitoring, verification, and accounting) Deployment."
- With regard to the upcoming U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) Atlas V:
  - Reviewed and prepared comments on the draft Bell Creek-related pages for the DOE Atlas (comments sent January 12).
- With regard to the partners-only decision support system (DSS) Web site:
  - Began collecting images from the last version of the PCOR Partnership Atlas to put in the image gallery on the DSS Web site.
  - Worked on maintenance issues.
  - Continued to assemble a presentation on the DSS online mapping services to showcase the capabilities for viewing results in a comprehensive and interactive framework outside of a report.
  - Continued working with programming to improve the online geographic information system map.
  - Updated North Dakota and Montana Petra projects with the latest general well information from each state's online resource as follows: 67 new North Dakota wells and one new Montana well.
- Created a new geodatabase to use for Bell Creek sampling locations.
- Continued work on several value-added reports, including the following:
  - Submitted the draft value-added regional characterization report, to DOE on January 9, 2015.
  - Began work on the Inyan Kara Formation report and gathered references.
  - Continued work on the report summarizing methods of original oil in place and carbon dioxide (CO_2) storage calculations.
  - Continued efforts on the Cedar Creek Anticline white paper, including sections on enhanced oil recovery (EOR), geologic history, wellbore integrity, and cement tops.

- With regard to the **Aquistore core work** (12 samples):
  - Submitted the draft value-added lab report to DOE on January 30, 2015.
- With regard to the **Aquistore** project's static modeling and dynamic predictive simulations effort.
  - Uploaded the remaining pressure and saturation data from the Energy & Environmental Research Center's (EERC's) simulation results to a file transfer protocol site for the Petroleum Technology Research Center (PTRC) Science and Engineering Research Committee to run seismic simulations for the Aquistore project.

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

Highlights

- Attended the 2015 National Energy Education Summit (www.ncseonline.org/2015-national-energy-education-summit) and the Energy and Climate Change 15th National Conference and Global Forum on Science, Policy, and the Environment (www.energyandclimatechange.org/) in Washington, D.C.
- Upon request, provided a copy of the 2010 outreach action plan to the Enhanced Oil Recovery Institute.
- Accepted an invitation to present at the Lignite Energy Council's teacher seminar on July 16, 2015.
- Received an invitation to present at the University of Jamestown, Jamestown, North Dakota, in March.
- Tentatively planning to attend the North Dakota Science Teachers Association Spring Meeting on March 20 and 21 in Bismarck.
- In lieu of an Aquistore outreach advisory working group conference call, PTRC provided an e-mail summarizing planned activities for the next quarter for the Aquistore project, which was reviewed.
- 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 Zama projects.
- Continued working on the update to the Bell Creek project poster (Deliverable [D]25, due March 31, 2015).
- Participated in the monthly Regional Carbon Sequestration Partnership (RCSP) Outreach Working Group conference call on January 22, 2014, and discussed the revision of the NETL Outreach Best Practices Manual (BPM) and content/schedule of upcoming calls.
- Continued efforts with regard to the public Web site (www.undeerc.org/pcor), including the following:
  - Continued ongoing identification and repair of broken links.
  - Held an in-house meeting on January 22, 2015, to discuss content in the regulatory and permitting section of the public Web site.
  - Worked on draft text to update the Basal Cambrian system project section.
- Continued collaborative efforts with Prairie Public Broadcasting (PPB), including the following:

- Traveled to Houston, then Plano, Texas, January 11–12, 2015, for filming at Rice University and then North American Coal Corporation's headquarters, respectively, and to attend other side meetings.
- Continued to review historical sources for the coal documentary, including *Energy and the English Industrial Revolution* by E.A. Wrigley, *Power to the People* by Kandar and others, and *Getting the Coal Out* by Diana Tittle.
- Continued efforts to schedule Dr. Friedmann for an interview for the 60-minute energy and coal documentary (D22).
- Received initial summary of site views for the video clips housed on the PPB Learning Media Web site (July–December 2014).

Task 3 – Permitting and NEPA (National Environmental Policy Act) Compliance (Charles D. Gorecki)

Highlights

- Met in-house to discuss the 2015 Regulatory Roundup.
- On January 30, 2015, sent an e-mail to selected regional regulators soliciting input on scheduling the next Regulatory Roundup meeting.
- Reviewed past NEPA questionnaires.
- Held a conference call with the Interstate Oil and Gas Compact Commission, and discussed potential topics for briefing paper(s) to be submitted for inclusion at the May annual meeting in Salt Lake City.
- Continued review of the U.S. Environmental Protection Agency (EPA)-proposed rule for carbon emissions from existing stationary sources.
- Continued planning for D8, Permitting Review – Update 2, due September 30, 2015, including checking the status of North Dakota primary application, and changes to the Canadian and U.S. EPA regulations.

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

Highlights

- **Bell Creek** test site activities included the following:
  - With regard to geomechanical activities:
    - Submitted D32, Geomechanical Report Update, on January 30, 2015.
    - Conducted literature review regarding geomechanical simulations.
      - Worked on preparing data and the overall simulation workflow.
    - Continued geomechanical characterization of the Bell Creek Field, including updating the properties of the 3-D mechanical earth model.
  - Continued investigating options regarding microseismic data-processing services and 3-D vertical seismic profiling (VSP) data processing.
  - Continued developing ideas for a Bell Creek journal article related to facies modeling to be prepared in collaboration with Denbury.
  - Developed a workflow for reprocessing the sigma pulsed neutron logs (PNLs). The results will be compared to the Version 2 geologic model's reservoir properties and will serve as a way to quality-control the model. Additionally, the saturations from the

baseline PNLs will be compared to the history-matched simulation results to help validate the results.
- Reviewed information from wells in the southeastern part of the field from the baseline 3-D surface survey interpretation for characterization purposes.
- Worked on developing well sections and cross sections (from the model and characterization data) for the laboratory to help facilitate the core work.
- Worked on incorporating lab-generated data into Techlog for use in the upcoming petrophysical modeling.
- Compiled lab data and well logs for 05-06 OW, 33-14R, and 56-14R wells.
- Continued working on Version 3 of the geologic model, including constructing facies logs for each of the wells that have core and lab data.
- 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 x-ray diffraction data.
    - Continued work on the permeability-to-air report.
  - With regard to the 56-14R full-core plugs (collected March 2013):
    - Permeability to water analysis continued, with two samples remaining.
    - Worked on obtaining pore-size and grain-size distributions for Bell Creek U.S. Geological Survey wells (lab work).

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

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

Task 6 – Infrastructure Development (Melanie D. Jensen)

Highlights

- Continued preparation of the update to the "Opportunities and Challenges Associated with CO_2 Compression and Transport During CCS (carbon capture and storage) Activities" report (D85, due March 2015). The document focuses on the methods used to prepare CO_2 for pipeline transport—compression and liquefaction—discussing the basis for each method as well as any new approaches and the situations in which one approach might be preferred over another. To the extent possible, the energy requirements and economics of each approach will be included.
- A value-added report entitled "Assessing Temporary Storage Options to Manage Variable-Rate CO_2 Emissions for Use During Enhanced Oil Recovery" continued undergoing internal PCOR Partnership management review. Following DOE review, the authors plan to submit the manuscript for possible publication in *Energy & Environmental Science*.
- Continued to update technologies for the CO_2 capture technologies update overview.

Task 7 – CO_2 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

- Nothing to note at this time.

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

Highlights

- Worked on renewing software licenses with CMG.
- **Bell Creek** injection-phase site activities included the following:
  - Continued to work with Denbury personnel to collect periodic oil and gas samples from select wells in the Phase 1 area.
  - Traveled to Bell Creek, downloaded data from the Qorex and MOREVision systems, and swapped hard disk drives on the GeoPro system, and continued reservoir surveillance and analysis of continuous permanent downhole monitoring data in the 05-06 OW well, January 14–16, 2015.
  - Continued injection-phase sampling work, including the following:
    - For the December 2014 quarterly water and soil gas data sets:
      - Completed data collection and analysis on over 210 soil gas samples collected from Phases 1 and 2. Processing is under way.
      - Completed analysis and processing for water parameters from the select group of nine wells in and around the injection zone.
      - Updated the near-surface monitoring project database and interactive map product with the most recent December 2014 data results.
    - Continued development of the Bell Creek water sampling and analysis prioritization protocol document.
  - Based on the most recent publicly available data, cumulative CO_2 injection is 1,361,551 metric tons through September 30, 2014 (Table 1).
  - Data processing is almost complete for the recently completed 3-D surface seismic survey at Bell Creek (Global Geophysical is doing the processing) and will be sent to the EERC when it is finished.

Table 1. Bell Creek CO_2 Injection Totals for September 2014 (cumulative totals May 2013 to September 2014)

	September 2014 Injection
Total, Mscf	2,202,088
Total, U.S. tons*	125,956
Total, metric tons*	114,376
Cumulative Total, Mscf [+]	26,213,934
Cumulative Total, U.S. tons*[+]	1,499,396
Cumulative Total, metric tons*[+]	1,361,551

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.

[+] Cumulative totals are for the period from May 2013 to the month listed.

- Held an internal meeting to discuss and formalize plans related to Bell Creek PNL interpretation, analysis, and integration activities over the next 5 months.
- Began work on the MVA BPM, and held an in-house brainstorming meeting to discuss.
- Received 3-D VSP monitor survey data and comprehensive backup material from processing, and provided a breakdown of the shotpoints survey and shotpoints acquired.
- Held a meeting to discuss modeling, simulation, and historical well data collection activities relevant to the MVA program.
- Estimated fracture pressure for some hypothetical scenarios.
- Received updated guidance from Denbury regarding field operations, proceeding with running additional simulation scenarios to investigate injection performance.
- Began checking results of the most recently collected PNLs as part of the quality assurance/quality control process, and updated the templates for examining the reservoir and well profiles in Petrel.
- Shared lessons learned from PNL work with PTRC.
- Continued the literature review for CO_2 EOR simulation strategies.

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

- Submitted the annual assessment (D57) on December 30, 2014.

Task 13 – Project Management (Charles D. Gorecki)

Highlights

- Continued preliminary efforts for the Adaptive Management Approach BPM (D102, due June 2015).
- Tentatively selected Chicago as the location for the 2015 annual meeting, and continued planning.
- Participated in a WebEx with the other partnerships and DOE regarding the upcoming DOE BPMs. There will be five BPMs, and they will be due in March and May 2016. DOE is forming teams with a member from each partnership for each BPM, with face-to-face kickoff meetings to be held for each team (likely in Pittsburgh). EERC staff were assigned for each BPM.
- Submitted an abstract to CCUS-14 (April 28 – May 1, 2015) entitled "Implementing Carbon Capture and Storage: An Overview of the Plains CO_2 Reduction Partnership."
- Held a task leader meeting January 6, 2015. Topics discussed included updates on Bell Creek and Aquistore, upcoming deliverables/milestones and travel, and updates from task leaders present.

- Continued planning for the winter Technical Advisory Board (TAB) meeting, including a draft agenda. TAB members were contacted with meeting information. The destination is Phoenix, Arizona, March 3–4, 2015.
- Met with The CETER Group at the EERC to discuss future PCOR Partnership reports/ products.
- An abstract submitted to the International Forum on Recent Developments of CCS Implementation (http://co2quest.eu/ccsforum15.htm) in Athens, Greece, was accepted for oral presentation. Requested and received foreign travel approval to present at the forum scheduled for March 26–27, 2015.
- Deliverables and milestones completed in January:
  - December monthly update
  - Task 9: D32 – Bell Creek Test Site – Geomechanical Report (Update 1)
  - Task 12: D58/D59 – Quarterly Progress Report
  - Task 14: M23 – Monthly Water Working Group (WWG) Call Held

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

Highlights

- DOE NETL officially released the WWG Web site (www.netl.doe.gov/research/coal/carbon-storage/wwg).
- Held the monthly conference call on January 27, 2015. Hosted a WebEx from DOE's Crosscutting Group where its various program initiatives were discussed, which include proposed funding for new treatment methodologies for CCS extracted brine and for a national water atlas. The outline for the BPM was also discussed, and several comments were made related to structure and content and options for the upcoming annual meeting.
- Received notice of the Groundwater Protection Council's annual underground injection control conference to be held in mid-February in Austin, Texas; attendance is under consideration.
- Continued the redesign of the water–CCS nexus graphic for both the WWG Web site and future fact sheet revisions.
- Continued working with the consultant on the BPM (D80, due November 30, 2016):
  - Continued work on the outline, including creation of an "expanded outline," which includes draft text of the various sections and potential references. The outline was provided to the WWG for this month's call.

Task 15 – Further Characterization of the Zama Acid Gas EOR, CO_2 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

- January 11–14, 2015: traveled to Houston, Texas, to conduct interviews and film for the coal documentary.
- January 14–16, 2015: traveled to Miles City, Montana, for site work at the Bell Creek Station.
- January 23–28, 2015: traveled to Arlington, Virginia, to attend the National Energy Education Summit.

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.