Plains CO_2 Reduction (PCOR) Partnership Monthly Update
November 1–30, 2013

PHASE III ACTIVITIES

Task 1 – Regional Characterization (Wesley D. Peck)

Highlights

- Continued efforts to characterize saline formations for carbon dioxide (CO_2) storage, including the following:
  - Continued review of the value-added Broom Creek Formation outline.
  - Continued drafting value-added outlines for the Leduc and Minnelusa Formations.
  - Began literature review for the Inyan Kara Formation value-added outline.
- Continued work on several additional value-added reports, including the following:
  - Outline for a general regional characterization report summarizing all past and present efforts.
  - Report entitled "Montana Abandoned Oilfield Creation," approximating the oilfield boundaries in Montana based on oilfield information contained within oil well shape files.
  - Report summarizing methods of original oil in place and CO_2 storage calculations.
  - White paper on characterization of the Cedar Creek Anticline.
  - Report on characterization of the state of Nebraska for CO_2 storage opportunities.
- With regard to NATCARB (National Carbon Sequestration Database and Geographic Information System) activities:
  - Completed reloading data into the newly released geodatabase.
  - Continued work on the oil and gas reservoir/pool table.
  - Received the "call for data" and associated guidelines from the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) for its "Atlas V."
- Continued activities to update the content on the partners-only Decision Support System (DSS) and moved the 2013 Annual Membership Meeting information to the "test" site for review.
- With regard to the **Aquistore** project static modeling and dynamic predictive simulations effort:
  - Reviewed the Schlumberger Carbon Services (Schlumberger) model and compared to the Energy & Environmental Research Center (EERC) model.
  - Began work on the fine-scale model, including grid refinement around the injector and observation wells.
  - Calculated CO_2 mass storage for all pore volume cases in both the expanded and fine-scale models.

  - Documented the static modeling workflow.
  - Started to set up the model for simulation.

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

Highlights

- Continued an in-house review of outreach products using a standard, industry-accepted framework.
- Met with a partner in Grand Forks, North Dakota, on November 12, 2013, to review outreach materials.
- Accepted an invitation to present at the North Dakota–Minnesota Geographic Alliances Collaborative Workshop scheduled for June 17–20, 2014.
- Continued to provide input to the steering committee of the IEAGHG (IEA Greenhouse Gas R&D Programme) Social Research Network in preparation for its fourth meeting on January 14 and 15, 2014, in Calgary, Alberta, Canada.
- Continued efforts to expand/improve outreach-tracking efforts, including the following:
  - On November 22, 2013, met in-house to discuss the inclusion of tracking tags for the addition of the documentaries and video clips on YouTube.
  - Continued updating forms and database programming with regard to site-specific community outreach efforts.
- Participated in the PTRC outreach workshop held November 14, 2013, in Regina, Saskatchewan, Canada.
- On November 21, 2013, provided input on the draft abstract prepared by the Regional Carbon Sequestration Partnerships (RCSP) Outreach Working Group (OWG) for the 12th International Conference on Greenhouse Gas Technologies (GHGT-12).
- Continued efforts to prepare and update project-related fact sheets, including the following activities:
  - Continued drafting the four-page Lignite Field Validation Test site overview fact sheet.
  - Began planning value-added updates/revisions to the other Phase II site fact sheets.
  - On November 21, 2013, submitted the updated (value-added) Bell Creek fact sheet, modified to reflect the fact that CO_2 injection is now under way.
- Continued efforts to update the public Web site (www.undeerc.org/pcor), including the following:
  - Continued planning for the next update report (D13, due July 2014).
  - Continued updates to the layout of the fact sheet page.
  - Continued a status review of all internal as well as external linked information, and repaired broken links.
- Continued collaborative efforts with Prairie Public Broadcasting (PPB), including the following:
  - Met with PPB personnel on November 19, 2013, to discuss budgets, upcoming master teacher training, and participation in a carbon capture, utilization, and storage (CCUS) workshop next July.
  - Continued preparations for the focus group scheduled for December 6, 2013, and run by PPB's education group to help in developing and evaluating educator-based outreach materials.

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

Highlights

- Attended the 2013 Interstate Oil and Gas Compact Commission (IOGCC) Annual Meeting (www.iogcc.state.ok.us/agenda) on November 4–6, 2013, in Long Beach, California, where the chair of the Carbon Geologic Storage Task Force presented "CO_2 Phase III: Guidelines for States & Provinces on Operational and Postoperational Liabilities."
- Reviewed DOE comments on the IOGCC Phase III draft report. Contacted various task force members to discuss and review DOE comments.
- Attended the North Dakota Industrial Commission (NDIC) hearing held November 13, 2013, in Grand Forks, where the petition of an energy company for unitized management, operation, and further development was heard.
- With regard to the Lignite Field Validation Test site (Phase II) closure, continued efforts to monitor the site during the reclamation phase, including a site visit on November 29, 2013.

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

Highlights

- **Fort Nelson** test site activities included the following:
  - Discussed characterization work with an interested partner.
  - Continued to work on revisions to the Fort Nelson Test Site – Site Characterization Report (received from Spectra Energy Transmission [Spectra] on February 1, 2013).
  - Continued to work on revisions to the Fort Nelson Test Site – Geochemical Report (received from Spectra on February 7, 2013).
- **Bell Creek** test site activities included the following:
  - Continued work on the wellbore leakage final report (D36, due March 2014), including the following:
    - Continued evaluation of wells to document utilized remedial measures.
    - Began review of bacteria-based CO_2 remediation technology.
    - Analyzed a sample of casing corrosion recovered from a nearby offset well outside the injection area (03-09) to identify and characterize corrosion mechanisms not related to CO_2.
    - Continued work on the complementary mitigation plan.
  - Continued preparing for the 3-D mechanical earth model (MEM) and geomechanical modeling and simulations.
  - Worked on updating the properties in 1-D MEM and 3-D MEM in Techlog and Petrel.
  - With regard to Applied Geology Lab activities:
    - Finalized the value-added petrophysical assessment report (including 21 well packages) of 81 intervals of core from the U.S. Geological Survey (USGS) Denver Core Research Center (CRC).
      - Sent the report and remaining core samples to CRC on November 22, 2013.
      - Uploaded the report for Denbury Resources Inc. (Denbury) on November 19, 2013.
      - Began preparing the report for submittal to DOE NETL.

    - ♦ With regard to the 33-14R core (collected April 2013), Denbury released the samples to Core Labs, and validation work began the last week in November.
    - ♦ With regard to the 56-14R sidewall core (21 samples, collected March 2013), efforts are on hold regarding testing one sample for porosity and another for SEM (scanning electron microscopy) mineral mapping (using thin section).
    - ♦ With regard to the 56-14R full-core plugs (collected March 2013), discussions continued regarding planned additional analyses for 56-14R full-core plugs (CO_2 exposure and comparisons to static vs. flow-through testing).
  - With regard to SCAL (special core analysis) work:
    - ♦ Searched for and reviewed the core-selecting method for SCAL tests.
    - ♦ Reviewed Core Labs experimental results.
  - Lab staff visited on November 14 and 15, 2013, with personnel at Coretest Systems, Inc., and Stanford University, both in California, to evaluate relative permeability methodologies and equipment options.

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

Highlights

- Began preparation of a presentation based on the Bell Creek monitoring program for CO_2 Conference Week scheduled for December 9–13, 2013, in Midland, Texas (www.co2conference.net/).
- Began drafting a protocol for groundwater sampling if a measured field parameter (pH, alkalinity, specific conductivity) falls outside the range of a 95% confidence interval as established during baseline monitoring, verification, and accounting (MVA) sampling and analyses.
- Continued work on the value-added baseline surface and near-surface MVA report and appendixes (data from all six sampling and analysis events), and completed review of the water analyses appendices.

Task 6 – Infrastructure Development (Melanie D. Jensen)

Highlights

- Continued work on a journal article (about the attenuation of variable CO_2 sources for use in enhanced oil recovery [EOR]). This article replaces D85 (Opportunities and Challenges Associated with CO_2 Compression and Transportation During CCS Activities, due March 2013) and is due by year's end. The journal selected is *Energy & Environmental Science* (www.rsc.org/publishing/journals/ee/about.asp).
- Presented at the 9th Annual Power Summit cohosted by Nebraska Public Power District (NPPD) and Nebraska Department of Environmental Quality in Lincoln, Nebraska.

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

- **Bell Creek** injection-phase site activities included the following:
  - Cumulative CO_2 injection is 180,752 metric tons through September 30, 2013 (Table 1).
  - Brainstormed ideas to streamline the deliverable review process.
  - Collected produced oil samples from 33-12 and 56-14R.
  - Continued work on refining the automated procedure for processing the permanent downhole monitoring (PDM) data.
  - Participated in a Webinar entitled "Simulating Geological Sequestration of CO_2 with COMSOL Multiphysics" on November 12, 2013, to determine the software's applicability to Bell Creek modeling activities.
  - Participated on November 12, 2013, in a WebEx with Denbury focusing on CO_2–oil-phase behavior.
  - Continued work on the value-added report entitled "Laboratory Evaluation of Potential CO_2–Rock–Groundwater Interactions Within the Groundwater Zone Overlying the Bell Creek Reservoir."
  - Started preliminary simulation work of the Bell Creek oil field, Phase 2.
  - Conducted literature reviews on the following topics:
    - CO_2 WAG (water alternating gas) hysteresis trapping.
    - Performing petrophysical analysis on pulsed-neutron logs (PNLs).

Table 1. Bell Creek CO_2 Injection Totals May 2013 – September 2013

	May 2013 Injection	June 2013 Injection	July 2013 Injection	August 2013 Injection	September 2013 Injection
Monthly Total, mscf*	187,073	932,103	590,030	648,220	1,122,584
Monthly Total, m[3][1]	5,297,318	26,394,221	16,707,791	18,355,549	31,788,043
Monthly Total, U.S. short tons[2]	10,700	53,315	33,749	37,077	64,210
Monthly Total, metric tons[3]	9,717	48,413	30,646	33,669	58,307
Cumulative Total, mscf	187,073	1,119,176	1,709,206	2,357,426	3,480,010
Cumulative Total, m[3][1]	5,297,318	31,691,539	48,399,330	66,754,878	98,542,921
Cumulative Total, U.S. short tons[2]	10,700	64,015	97,764	134,841	199,051
Cumulative Total, metric tons[3]	9,717	58,130	88,776	122,445	180,752

* Source: Montana Board of Oil and Gas (MBOG) Online Database.

[1] Calculated utilizing conversion of 28.31685 m^3/Mscf (NIST.gov Special Publication 1038).

[2] Calculated utilizing conversion of 17.483 Mscf/U.S.short ton.

[3] Calculated utilizing conversion of 19.253 Mscf/metric ton.

Note: There is an approximately 2–3-month delay in posting injection/production volumes to the MBOG database.

- Continued seismic data interpretation as follows:
  - Continued evaluating methods to derive the rock mechanical properties from seismic data.
  - An in-house meeting was held to discuss the current analysis of the 3-D seismic data.
  - Continued assessing various techniques used for the estimation of stress using 3-D seismic data.
- Continued work on the PNLs, including the following:
  - Participated on November 15, 2013, in a WebEx with Schlumberger personnel to discuss the repeat PNL results on 05-01.
  - Continued analyzing water and oil saturations computed from PNLs and began 3-D modeling.
- Worked on setting up Version 3 geologic model.
- Compiled all core descriptions from USGS, Exxon, and the Bureau of Environmental Geology, and began mapping facies in cross sections throughout the field to look for trends.
- Continued injection-phase sampling work, including the following:
  - Continued work on the Bell Creek Test Site – First Full-Repeat Sampling of the Groundwater- and Soil Gas-Monitoring Program Completed (M43, due December 2013).
  - Traveled to the Bell Creek site during the week of November 10, 2013, to complete the October event sampling and complete the near-monthly Phase 1/SGPS (soil gas profile station)/interspaced-well sampling.
  - Completed the first full-repeat surface and near-surface water and soil gas-sampling event on November 15, 2013.
  - Completed statistical analyses of the July and August 2013 soil gas CO_2 measurements for active wells (35 and 61 samples, respectively), interspaced locations (9 and 10 samples, respectively), and plugged and abandoned wells (three directional samples at three wells during July and August).
  - Continued processing water field data from the November 2013 sampling events for the Fox Hills Formation (two samples total) and the remaining sites not previously sampled in October because of snow accumulation (eight total).
  - Began processing September 2013 soil gas data for the SGPS wells (ten) at the three sampling depths (3.5 ft, 9.0 ft, and 14 ft).
  - Began processing additional results from the September/October 2013 sampling event for active wells (80 samples), interspaced locations (two samples), and plugged and abandoned wells (eight samples).

- **Fort Nelson** site activities included the following:
  - Continued reviewing previous simulation results to investigate the CO_2 plume output.
  - Continued efforts to draft an overview of the feasibility study activities, including the following:
    - Compile a comprehensive report summarizing technical activities.
    - Prepare a document comparing and contrasting Fort Nelson characterization, modeling, and risk assessment work with the Canadian Standards Association (CSA) Guidelines for Geological Storage of CO_2.

    - ♦ Prepare a rudimentary MVA plan that combines the existing shallow-surface MVA plan with a new deep-subsurface MVA plan in order to create a comprehensive MVA plan that is compliant with the CSA guidelines.
  - Continued review of Spectra's comments on the Fort Nelson Test Site – Simulation Report (D67, originally submitted September 2011). Comments were received February 4–7, 2013, and revisions are under way.

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

- This task is anticipated to be initiated in Quarter 1 – Budget Period (BP) 5, 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

- Began work on D57, the annual assessment report, due December 31, 2013.

Task 13 – Project Management (Charles D. Gorecki)

Highlights

- Submitted the October monthly update on November 7, 2013, and uploaded the report to the DSS.
- Continued reviewing recommendations for the organization of PCOR Partnership data, especially all of the data generated regarding the Bell Creek project.
- Reviewed abstracts for the upcoming 76th EAGE (European Association of Geoscientists and Engineers) Conference and Exhibition 2014.
- Continued preparations for the IEAGHG 2013 Expert Review of the RCSP Initiative, including the following:
  - Presented the PowerPoint to the in-house PCOR Partnership team for comment on November 12, 2013.
  - Gave a 45-minute presentation before the expert panel on November 14, 2013, in Washington, D.C., and participated in the 45-minute question-and-answer session following the presentation.
- Participated in a conference call with BillyJack Consulting on November 18, 2013.
- Held several calls with Denbury to discuss and coordinate invoice tracking and revised cost-share reporting.
- Conducted the monthly task leader meeting on November 26, 2013. Topics discussed included an overview of the expert panel review; updates on the Bell Creek, Fort Nelson, Aquistore, and Basal Cambrian projects; a review of upcoming conferences and deliverables; and updates from each task leader present.
- Attended the North Dakota Lignite Research Council meeting in Bismarck, North Dakota, and visited with several partners that were present.

- Deliverables and milestones completed in November:
  - October monthly update
  - Task 14: M23 – Monthly Water Working Group (WWG) conference call held

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

Highlights

- Scheduled and held the monthly conference call on November 21, 2013. Agenda items included the following:
  - Welcome new participants (if needed)
  - WWG fact sheet topic selection
  - GHGT-12 abstract/paper ideas
  - WWG deliverable approval
  - RCSP updates
- Distributed the notes from the October conference call on November 21, 2013. Seven persons participated representing three partnerships. Topics discussed included:
  - Finalization of the MVA fact sheet (D99-2 due October 31, 2013).
  - Overview of Carbon Management Technologies Conference.
  - Potential water-focused session at GHGT-12.
  - Plan to contact the RCSPs to confirm their WWG contacts (primary and backup).
  - Topics for next fact sheet (D99-3 due October 2014).
  - Discussion of upcoming deliverables, e.g., water resource estimation methodology report (2014) and best practices manual (2016).
- DOE NETL waived the requirement for the December conference call on November 21, 2013.
- Held a conference call with the NETL project manager on November 25, 2013.
- Evaluated two water-related risk assessment tools created by the International Petroleum Industry Environmental Conservation Association and the Global Environmental Management Initiative for the oil and gas industry.
- Began drafting abstracts for GHGT-12 (due January 10, 2014).

Task 15 – Further Characterization of the Zama Acid Gas EOR, CO_2 Storage, and Monitoring Project (Charles D. Gorecki)

Highlights

- Continued work on the Updated Regional Technology Implementation Plan for Zama (D86, due February 2014), and met in-house on November 25, 2013 to discuss progress.

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

Highlights

- Submitted on November 22, 2013, the revised report entitled "Wellbore Evaluation of the Basal Cambrian System" (D90), including modifications to the shallow well leakage factor and spud date information.
- With regard to the **Aquistore** project (20 core samples) mineralogical characterization:
  - Completed water permeability testing on nine of the 11 samples.

– Completed gas permeability testing on 20 of 20 samples.

Travel/Meetings

- November 2–7, 2013: Attended the 2013 IOGCC Annual Meeting in Long Beach, California.
- November 4–5, 2013: Presented at the 9th Annual Power Summit in Lincoln, Nebraska.
- November 10–16, 2013: Traveled to the Bell Creek area for sampling activities.
- November 13–15, 2013: Presented at the Fiscal Year 14 RCSP Expert Review in Washington, D.C.
- November 13–15, 2013: Participated in a PTRC outreach workshop in Regina, Saskatchewan, Canada.
- November 13–16, 2013: Visited Stanford University and Coretest in San Francisco and Santa Cruz, California, respectively.
- November 19, 2013: Attended a meeting with PPB at its offices in Fargo, North Dakota.
- November 19, 2013: Attended the North Dakota Lignite Research Council meeting in Bismarck, North Dakota.
- November 29, 2013: Inspected the Phase II Lignite Field Validation Test site near Kenmare, North Dakota.

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