



**Plains CO₂ Reduction (PCOR) Partnership Monthly Update
October 1–31, 2013**

PHASE III ACTIVITIES

Task 1 – Regional Characterization (Wesley D. Peck)

Highlights

- Continued efforts to characterize saline formations for carbon dioxide (CO₂) storage, including the following:
 - Continued updating the Broom Creek Formation outline.
 - Continued drafting new outlines for Leduc and Minnelusa Formations.
- Continued work on several value-added reports, including the following:
 - Report entitled “Montana Abandoned Oil Field Creation” where we made an effort to approximate the oil field boundaries in Montana based on oil field information contained within oil well shape files.
 - Report summarizing methods of original oil in place and CO₂ storage calculations.
 - Report on characterization of the Cedar Creek Anticline.
 - Report on characterization of the state of Nebraska for CO₂ storage opportunities (in internal review).
- With regard to NATCARB (National Carbon Sequestration Database and Geographic Information System) activities:
 - Compiled statistics for NATCARB data and wrote up notes for changes that were made since last NATCARB submission. Began collecting data related to saline storage modeling outputs.
 - Completed initial upload of data.
 - Uploaded Mission Canyon model data into geodatabase.
 - Participated in conference call on October 30, 2013, regarding NATCARB data and the upcoming U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) Atlas, Fifth Edition.
- Continued activities to update the content on the partners-only Decision Support System (DSS), including the following:
 - Began building the 2013 Annual Membership Meeting Web page.
 - Worked closely with programming staff to continue assembling the pop-up reports with CO₂ and enhanced oil recovery (EOR) estimates related to oil fields/pools.
 - Met in-house October 24, 2013, to review proposed changes currently housed on a test site.

- With regard to the Aquistore project static modeling and dynamic predictive simulations effort:
 - Calculated CO₂ density from formation depth, temperature, and pressure data and distributed it in the static model.
 - Continued reviewing permeability versus porosity relationship for Black Island and Deadwood Formations using available core data
 - Continued work populating the static geologic model.
 - Populated the expanded model with horizontal permeability.
 - Began populating the fine-scaled model.

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

Highlights

- Initiated a review of the status of all internal as well as external links on the public Web site.
- Continued an update to forms and programming for the community outreach section of outreach tracking database.
- Continued an in-house review of outreach products using a standard, industry-accepted framework.
- Met on October 4, 2013, to discuss plans for D24, CO₂ general storage poster, due March 2014.
- Provided comments 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.
- Prepared for participation in the PTRC outreach workshop scheduled for November 14, 2013, in Regina, Saskatchewan, Canada.
- Continued efforts to prepare and update project-related fact sheets, including the following activities:
 - Prepared a schedule for completing the updates/revisions to the Phase II site fact sheets.
 - Continued drafting the 4-page Lignite Field Validation Test site overview fact sheet.
 - Began updating the Bell Creek fact sheet to reflect the fact that CO₂ injection is now under way.
- Continued efforts to update the public Web site (www.undeerc.org/pcor): updates included the addition of four regional technology implementation plans for Phase II validation activities, the Phase II final report, and the NETL validation phase fact sheet.
- Continued collaborative efforts with Prairie Public Broadcasting (PPB), including the following:
 - Traveled to the Boundary Dam power plant on October 23, 2013, near Estevan, Saskatchewan, Canada, to film interviews and location footage of the power plant and the CO₂ capture facility.
 - Previewed and discussed Parts 1 and 2 of the four-part educators Carbon and Energy video series in-house on October 16, 2013.
 - Continued discussions with PPB about creating a focus group to help in developing and evaluating educator-based outreach materials.
- Prepared information and a presentation for a partner and continued to work on outreach materials following a meeting on October 14, 2013.

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

Highlights

- Participated on October 8, 2013, in a North America 2050 Sequestration Working Group Webinar – Demonstrating Carbon Storage.
- Worked with Interstate Oil and Gas Compact Commission (IOGCC) staff in preparing Web site, fact sheets, and final report layout for the Report – Findings, Recommendations, and Guidance of the Carbon Geologic Storage Task Force on Operational and Postoperational Liability (D98), currently under review by DOE NETL.
- Reviewed proposals by western U.S. states and Canadian provinces to align their greenhouse gas reduction targets.
- Began review of British Columbia's proposal to update its Water Act with the new Water Sustainability Act.
- With regard to the Lignite Field Validation Test site (Phase II) closure:
 - Submitted a draft value-added report on closure activities on October 30, 2013.
 - Continued efforts to monitor the site during the reclamation phase, including a site visit on October 10, 2013, and found no fence breaks. Voltage at the gate was low, which is consistent with readings during other trips with heavy cloud cover.

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

Highlights

- **Fort Nelson** test site activities included the following:
 - 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 evaluation of wells for the wellbore leakage final report (D36, due March 2014).
 - Continued work on the 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.
 - Revised the geomechanical report (D32) and sent it to Denbury for review on October 24, 2013.
 - With regard to Applied Geology Lab activities:
 - ♦ Continued review and modification of the value-added petrophysical assessment report (including 21 well packages) of 81 intervals of core from the U.S. Geological Survey Denver Core Research Center.
 - ♦ Discussed with Denbury on October 11, 2013, the release of 33-14R core from Core Labs.
 - ♦ With regard to the 56-14R sidewall core (21 samples), determined that one sample will be tested for porosity and another for SEM (scanning electron microscopy) mineral mapping (using the thin section).

- ♦ On October 2, 2013, planned additional analyses for 56-14R full-core plugs (CO₂ exposure and comparisons to static vs. flow-through testing).
- ♦ Received 03-09 casing for corrosion evaluation and began sample preparations on October 8, 2013.
- With regard to SCAL (special core analysis) work:
 - ♦ Reviewed SCAL results using the U.S. Bureau of Mines methods for wettability and capillary pressure.
 - ♦ Met in-house to discuss progress, following a phone call with Core Labs.

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

Highlights

- Submitted the Injection Experimental Design Package (D42) on October 31, 2013.
- Invited to present on the Bell Creek monitoring program at the CO₂ Conference Week scheduled for December 9–13, 2013, in Midland, Texas (www.co2conference.net/).
- Presented a poster entitled “Baseline Soil Gas Monitoring at the Bell Creek Combined CO₂ EOR and CO₂ Storage Project” at the Carbon Management Technology Conference (CMTTC) held October 21–23, 2013, in Arlington, Virginia.
- Attended the North American Wellbore Integrity Workshop in Denver, Colorado.
- Continued work on the value-added Baseline Surface and Near-Surface MVA report and appendixes (data from all six sampling and analysis events).
- Continued work on the milestone tentatively entitled “Bell Creek Test Site – First Full-Field Annual Operational Phase Sampling of the Groundwater and Soil Gas-Monitoring Program” (M43, due December 2013).

Task 6 – Infrastructure Development (Melanie D. Jensen)

Highlights

- Continued information searches needed to update the capture technologies overview document (value-added report, 2011) and its companion interactive DSS Web page.
- Estimated (using several different sets of assumptions) the carbon footprint of a processing system for drill cuttings in which diesel is driven off of the cuttings and captured for reuse elsewhere.
- Discussed the journal article (about the attenuation of variable CO₂ sources for use in EOR) with consultants. This article replaces D85 (Opportunities and Challenges Associated with CO₂ Compression and Transportation During CCS Activities, due March 2013) and is due by year-end. The journal selected is *Energy & Environmental Science* (www.rsc.org/publishing/journals/ee/about.asp).

Task 7 – CO₂ 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

- Modeling staff attended the Society of Petroleum Engineers ATCE (Annual Technical Conference and Exhibition) held September 30 – October 2, 2013, in New Orleans, Louisiana.
- **Bell Creek** injection-phase site activities included the following:
 - Presented “Characterization and Time-Lapse Monitoring of a Combined CO₂ EOR and CO₂ Storage Project at the Bell Creek Oil Field Utilizing Pulsed-Neutron Well Logging” at CMTC in Alexandria, Virginia.
 - Continued preparations for a WebEx with Denbury covering CO₂-phase behavior.
 - Continued ongoing processing of permanent downhole-monitoring data.
 - Experimented with MMPA (minimum miscibility pressure apparatus) techniques for near-surface 3-D model.
 - Continued merging the two CO₂-rock exposure test reports (Hell Creek and Fox Hills Formations) into a single value-added report.
 - Worked on predictive simulation.
 - Continued literature review and practicing geomechanical simulations with FLAC3D™ software.
 - Met in-house to discuss creation of a near-surface model from the Pierre Formation to the surface.
 - Conducted literature reviews on the following topics:
 - ♦ Experimentally setting initial water saturation.
 - ♦ CO₂ WAG (water-alternating-gas) hysteresis trapping.
 - ♦ CO₂ hysteresis in CO₂ flood.
 - ♦ Performing petrophysical analysis on pulsed-neutron logs (PNLs).
 - ♦ Estimation of stress using 3-D seismic data and leakage characterization using above-zone pressure monitoring.
 - Continued evaluating methods to derive the rock mechanical properties from seismic data.
 - Practiced 3-D seismic data viewing and interpretation in Petrel software.
 - Continued work on the PNLs, including the following:
 - ♦ Continued literature review and held discussions with Denbury consultant regarding water petrophysical calculations from PNLs.
 - ♦ Continued literature review for petrophysical analysis.
 - ♦ Continued analyzing water and oil saturations computed from PNLs.
 - ♦ Completed repeat PNL logging in 05-06OW and 05-07, and 05-05 wells.
 - ♦ Reviewed LAS (log ASCII standard) headers and outlined concerns and expectations moving forward with repeat logging.
 - ♦ Recomputed water and oil saturations for PNL logs through the reservoir zone and produced ArcGIS maps.

- Continued injection-phase sampling work, including the following:
 - ◆ Completed processing May and June 2013 soil gas data for the selected active wells, interspaced locations, and soil gas profile stations (SGPSs)—all were within the biological respiration range or below.
 - ◆ Began processing July and August 2013 soil gas data for the 10 SGPSs at three sampling depths (3.5 ft, 9.0 ft, and 14 ft).
- Wrapped up the October first full repeat surface and near-surface water and soil gas sampling event on October 6, 2013. Collected approximately 75% of the total samples (water and soil gas) and over 200 gas bags prior to the arrival of Winter Storm Atlas (Figure 1).
- Continued processing water data from June, July, August, and October 2013 sampling events for the two Fox Hills groundwater-monitoring wells (eight samples total) and the October 2013 first full repeat sampling event which sampled a majority of the sites (19 out of 24) before winter storm conditions.
- Began work on equipment maintenance and restocking for future sampling events.
- Began preparations for the next sampling trip scheduled for November 11, 2013, to complete the October event sampling and complete the near-monthly Phase 1/SGPS/ interspaced-well sampling.
- Continued work with Denbury personnel to collect monthly oil samples from three wells in the Phase 1 area.
- Continued work with Denbury personnel to collect a CO₂ sample from the injection stream.
- **Fort Nelson** site activities included the following:
 - 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 CO₂.
 - ◆ Prepare a rudimentary monitoring, verification, and accounting (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.
 - Collected, archived, and compiled soil gas field data sheets (handheld meter and field gas chromatograph) for August and September 2013 sampling events.



Figure 1. Pictures after Winter Storm Atlas near Hulett, Wyoming (top) and in Rapid City, South Dakota (bottom). (Top photo courtesy of Craig Seidel and bottom photo accessed from online Rapid City Journal, http://rapidcityjournal.com/photos/winter-storm-atlas/collection_82a122aa-6e17-55c6-af1a-d9931e65b578.html#4, on November 6, 2013).

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

- Uploaded the quarterly progress report on October 31, 2013.
- Presented “The Plains CO₂ Reduction Partnership: Demonstrating CO₂ Storage Solutions,” on October 21, 2013, at the EERC’s Air Quality IX Conference in Arlington, Virginia.
- Prepared for the IEAGHG 2013 Expert Review of the Regional Carbon Sequestration Partnerships (RCSP) Initiative, including the following:
 - Provided the final PCOR Partnership presentation on October 31, 2013.
 - Planned for a WebEx on November 1, 2013, to run through the expert review presentation for nonpanelist TAB (Technical Advisory Board) members.
 - Revised the Bell Creek project information form and PCOR Partnership presentation.
- On October 29, 2013, submitted a contract modification request regarding 1) the Bell Creek cost overrun; 2) Denbury-reported, in-kind cost share; and 3) a revised statement of project objectives, incorporating changes (new and approved) since June 2012.
- Prepared for a meeting at the EERC on November 5 and 6, 2013, to evaluate current data management practices (especially with regard to Bell Creek).
- Presented an overview of the PCOR Partnership Program to an EERC visitor, Omaha Public Power District, on October 18, 2013.
- Participated in a conference call with China National Petroleum Corporation on October 18, 2013, and shared information about the EERC’s work in the CO₂ EOR space, including PCOR Partnership activities.
- Submitted proposed changes upon request to NETL’s “PCOR Partnership – Development Phase Large-Scale Field Tests” on October 18, 2013.
- Attended the 2013 Midwest Carbon Sequestration Science Conference in Champaign, Illinois, October 7–9, 2013, and participated in a tour of the Illinois Basin – Decatur Project at the Archer Daniels Midland Company in Decatur, Illinois, on October 9, 2013. (www.sequestration.org/resources/PAGOct2013/index-PAG.html).
- Attended the Midwest Regional Carbon Sequestration Partnership Meeting hosted by Battelle and Core Energy in Traverse City, Michigan, October 2 and 3, 2013.
- Continued to review Program Year 7 budgets.

- Participated in conference call led by NETL on October 3, 2013, to continue the conversation that was started at the August annual review meeting and expand on the activities between the RCSPs and NRAP (National Risk Assessment Partnership).
- Held several calls with Denbury to discuss and coordinate invoice tracking and revised cost-share reporting.
- Conducted the monthly task leader meeting on October 1, 2013. Topics discussed included 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.
- Deliverables and milestones completed in October:
 - Task 5: D42 – Bell Creek Test Site – Injection Experimental Design Package
 - Task 13: D58/D59 – Quarterly Progress Report/Milestone Quarterly Report
 - Task 14: D99-2 – Water/CCS Nexus-Related Fact Sheet
 - Task 14: M23 – Monthly Water Working Group (WWG) conference call held

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

Highlights

- Submitted the draft MVA fact sheet entitled “Monitoring, Verification, and Accounting Plans for Protection of Water Resources During the Geologic Storage of Carbon Dioxide” (D99-2) on October 31, 2013.
- Held monthly conference call on October 31, 2013, to discuss recent activities and plans for a special WWG session at the 12th International Conference on Greenhouse Gas Technologies (GHGT-12).
- Distributed the notes from the August annual meeting on October 10, 2013.
- Distributed the notes from the September conference call on October 17, 2013.
- Presented “RCSP WWG: The Nexus of Water and Carbon Capture and Storage” at CMTC in Alexandria, Virginia.

Task 15 – Further Characterization of the Zama Acid Gas EOR, CO₂ Storage, and Monitoring Project (Charles D. Gorecki)

Highlights

- Discussed initial core work that was performed.
- Conducted a literature review for storage in complex structures.
- Investigated and ran Monte Carlo simulations to estimate storage capacity of Zama pools.
- Continued work on the Updated Regional Technology Implementation Plan for Zama (D86, due February 2014), more specifically rewriting the geologic modeling sections.

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

Highlights

- Presented “Carbon Sequestration Case Study: Large-Scale Exploration in a Basal Saline System in Canada and the United States” at CMTC in Alexandria, Virginia.
- Attended a 1-day workshop (following CMTC) regarding water management.

- Continued work on the final report (D92: Task 16 – Report – Storage Capacity and Regional Implications for Large-Scale Storage in the Basal Cambrian System, due March 2014).
- Compiled data for a manuscript using Bayesian classifiers and Bayesian networks to assess CO₂ leakage risk from wells in the Basal Cambrian.
- Presented “Wellbore Evaluation of the Basal Cambrian System in the U.S. Portion of the Williston Basin” at the North American Wellbore Integrity Workshop on October 16, 2013, in Denver, Colorado.
- With regard to the **Aquistore** project (20 core samples) mineralogical characterization:
 - Continued water permeability testing on nine of the 11 samples.
 - Scheduled relative permeability testing for late November 2013.
 - ♦ Selected three cores for testing.
 - ♦ Plan to use additional SEM characterization to understand the chemical and physical impacts to the cores from CO₂ exposure during relative permeability testing.
 - Initiated gas permeability testing on the remaining nine samples of the original 20. (*Note:* The original plans were for analysis of only 11 of the 20 samples; however, it was determined additional samples would be beneficial to the modeling efforts. All porosity and gas permeability data was provided to the modelers [see Task 1]).

Travel/Meetings

- September 27 – October 3, 2013: Attended SPC ATCE in New Orleans, Louisiana.
- September 29 – October 6, 2013: Visited landowners and performed soil gas and water sampling at the Bell Creek site.
- October 1–3, 2013: Attended the Midwest Regional Carbon Sequestration Partnership meeting in Traverse City, Michigan.
- October 7–9, 2013: Attended the 2013 Midwest Carbon Sequestration Science Conference in Champaign, Illinois, and toured the Illinois Basin – Decatur Project at the Archer Daniels Midland Company in Decatur, Illinois.
- October 10, 2014: Inspected the Phase II Lignite Field Validation Test site near Kenmare, North Dakota.
- October 15–17, 2013: Presented at the North American Wellbore Integrity Workshop on Denver, Colorado.
- October 20–23, 2013: Presented at CMTC in Alexandria, Virginia.
- October 20–23, 2013: Presented at Air Quality IX in Arlington, Virginia.

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