



Plains CO₂ Reduction (PCOR) Partnership
Energy & Environmental Research Center (EERC)

Plains CO₂ Reduction (PCOR) Partnership Monthly Update June 1–30, 2013

PHASE III ACTIVITIES

Task 1 – Regional Characterization (Wesley D. Peck)

Highlights

- Received the printed copies of the *Plains CO₂ Reduction (PCOR) Partnership Atlas, 4th Edition, Revised* (Deliverable [D] 81) on June 4, 2013.
- Continued reviewing and updating the attribute data for the CO₂ sources database (D1, due September 2013), including the following:
 - Updated the sources within the U.S. portion of the region.
 - Spent time trying to verify the existence of older sources.
 - Began updating the Canadian sources.
- Continued efforts to characterize the Cedar Creek Anticline (D7, due September 2013), including the following:
 - Continued development of a geologic and operational database.
 - Began developing a white paper on the geologic and operational database.
- Continued efforts to characterize additional saline formations for carbon dioxide (CO₂) storage, including the following:
 - Continued compilation of formation evaluations for six formations found in the PCOR Partnership region, namely the Broom Creek, Inyan Kara, Leduc, Minnelusa, Mission Canyon, and Winnipegosis Formations (Fms).
 - Continued to research permeability values of the Inyan Kara Fm in the Williston Basin with plans to use calculated permeability estimates to produce static models of potential geologic CO₂ storage.
 - Performed advanced analysis of Broom Creek Fm model.
 - Worked on volume uncertainty analysis (2013 Broom Creek study area and Washburn study area).
- Continued activities to update the content on the partners-only Decision Support System (DSS), including the following:
 - Completed adding updated Bell Creek information to the “Demonstration Projects” section on the test site.
 - Continued to update regional well information, i.e., for Manitoba and Montana, for the “Interactive Maps” section of the site.
 - Continued to add descriptions for the atlas images so they can be added to the “Image Gallery.”

- Continued work on a value-added oil field and reservoir report, including the following activities:
 - Continued revisions based on recent feedback regarding CO₂ calculations.
 - Completed writing the methodology section, including collection and calculation data.
- With regard to the Aquistore project static modeling and dynamic predictive simulations effort:
 - Continued review of the observation well and injection well suites of data, e.g., logs, sidewall core analyses, drilling reports.
 - Began building the static model.

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

Highlights

- Presented at the 2013 Lignite Education Seminar: Energy, Economics, and Environment on June 18, 2013, in Bismarck, North Dakota and distributed information packets (atlas, documentaries, fact sheets) to more than 130 teachers.
- Continued gathering “site-specific” community outreach information for the Bell Creek project.
- Continued collaborative efforts with Prairie Public Broadcasting (PPB), including the following:
 - Participated in the PPB Teacher Training Institute entitled “Integrating Regional History, Culture, Science and the Arts” on June 25 and 26, 2013, in Moorhead, Minnesota and distributed information packets (atlas, documentaries, fact sheets) to over 60 teachers.
 - Continued to work with PPB on Segments 1 and 2 (of 4) of the educator presentation video to be used at teacher training seminars and on the Web.
 - Continued to work with PPB on editing the PDM (permanent downhole monitoring) value-added video (using footage collected from Bell Creek Well 05-06 OW).
 - Continued preparations for filming with PPB at the Boundary Dam power plant on July 23, 2013.
 - Continued to coordinate with PPB on scheduling film trips for upcoming documentary projects.
- Continued efforts to review and improve the public Web site, including the following:
 - Continued work on updating the education section.
 - Continued Web research using Google Analytics.
- Continued assessing results from a survey of partner-related Web sites in order to determine how partners are sharing carbon capture and storage-related information.
- Participated in the monthly Aquistore Outreach Advisory Panel conference call on June 3, 2013.
- Participated in the monthly Regional Carbon Sequestration Partnership (RCSP) Outreach Working Group conference call on June 20, 2013.

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

Highlights

- Continued planning for the 5th Annual Regulatory Roundup scheduled for July 30–31, 2013, in Deadwood, South Dakota, including sending an e-mail announcing the hotel room block expiration date to participants.
- Reviewed and commented on an IEA Greenhouse Gas R&D Programme (IEAGHG) draft report entitled “Developing a small-scale CO₂ test injection: Experience to date and best practice.”
- Presented in the CO₂ Transportation session at the Introduction to CO₂–Enhanced Oil Recovery (EOR) Workshop held June 11 and 12, 2013, in Houston and Port Arthur, Texas. The workshop provided an overview of EOR and carbon capture, utilization, and storage to U.S. state and Canadian provincial regulators.
- Continued activities associated with the Interstate Oil and Gas Compact Commission (IOGCC) Carbon Geologic Storage (CGS) Task Force, including the following:
 - Hosted and led the CGS Task Force meeting on June 19 and 20, 2013, in Denver, Colorado. The Findings and Recommendations of the CGS Task Force Subgroups on Operational and Postoperational Liability were presented and accepted (with minor changes).
 - Reviewed the redline document that incorporated changes from the CGS Task Force meeting.
 - Prepared Milestone (M) 42 entitled “Findings and Recommendations of the Operational and Postoperational Subgroups Presented to the CGS Task Force” and submitted it to the U.S. Department of Energy (DOE) on June 28, 2013.
- With regard to the Lignite Field Validation Test site (Phase II) closure:
 - Continued to modify a draft value-added report on closure activities.
 - Continued efforts to monitor the site during the reclamation phase, including a site visit on June 19, 2013.

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

Highlights

- EERC staff participated in four half-day in-house Petrel software training sessions and a 1-hour training session led by Schlumberger Carbon Services (Schlumberger).
- 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 preparation of an AAPG (American Association of Petroleum Geologists) *Bulletin* journal article.
 - EERC staff traveled to an outcrop near Hulett, Wyoming, in preparation for a guided field trip for Denbury staff scheduled for August 10–15, 2013.
 - Continued preparation of a field guide for the Muddy Outcrop field trip.

- Reviewed several new technical papers regarding Muddy Sandstone geology.
- Discussed passive seismic monitoring and 3-D VSP (vertical seismic profiling) processing with Sigma³ at the Bell Creek site.
- Discussed the potential for a repeat survey in January 2014, in conjunction with Denbury's 4-D seismic survey.
- Continued work on the Bell Creek Test Site – Site Characterization Report (D64, due August 2013), including review of the following:
 - ◆ Over 674 well files
 - ◆ LIDAR (light detection and ranging) survey for 79 mi²
 - ◆ Over 60 cores, including descriptions
 - ◆ Over 748 well logs included in the geologic model
- Continued revisions to D32, geomechanical report (submitted January 31, 2013), based on Denbury Resources, Inc.'s (Denbury's) comments.
- Worked on improving the analytical geomechanical model.
- Continued work on the 3-D MEM (mechanical earth model) using Techlog and Petrel software.
- Continued outlining the information to be included in the Wellbore Leakage Final Report (D36, due March 2014).
- Continued work on the Bell Creek Test Site – Preinjection Geochemical Report (D33/M12, due July 2013).
- Continued review and modification of the petrophysical assessment (including 21 well packages) of 81 intervals of core from the U.S. Geological Survey Denver Core Research Center.
- Met in-house to discuss 56-14R and 33-14R core scope of work.
- Began photographing and describing thin sections for core collected from Well 56-14R.

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

Highlights

- Began planning for the annual fieldwide soil gas and water analysis (tentatively planned for October or November 2013).
- Discussed collecting oil and water, and incoming and recycled CO₂ samples, on a monthly basis at the Bell Creek site.
- Discussed the possibility of installing a temporary downhole pressure gauge in an injector and producer well for monitoring purposes.
- Continued Fox Hills Fm CO₂ exposure testing to evaluate potential impact of CO₂ [as recommended by the PCOR Partnership Technical Advisory Board (TAB)], as follows:
 - Completed mineralogical analyses (x-ray diffraction and x-ray fluorescence on the 33-12 drill cuttings. These data, along with water chemistry data from 33-12 groundwater, were used for PHREEQC model input data for CO₂-rock exposure simulations.
 - Completed a preliminary (1-week) exposure test to assess blending capabilities of mixed CO₂ and N₂ and the effects of different rock:water ratios. Began processing and summarizing corrected PDM data.
- Continued reviewing confirmatory analysis data for the Fox Hills groundwater-monitoring wells (05-04 and 33-12) from Cameron Cole Consulting regarding the monitoring well sampling conducted April 4, 2013.

- Analyzed reprocessed 05-06 OW PDM data after attempting to correct a calibration anomaly (coordinating efforts with PROMORE).
- Completed preinjection baseline monitoring on May 22, 2013, with six rounds of water sampling (surface and groundwater), five rounds of soil gas sampling, and one Fox Hills sampling event, and began review of the data.
- Continued revisions to the value-added Bell Creek monitoring, verification, and accounting (MVA) report (integrating final baseline sampling event).
- Continued download and analysis of pressure gauge response from the 05-06 OW well.

Task 6 – Infrastructure Development (Melanie D. Jensen)

Highlights

- Began editing a document describing the approach and results of a study of temporary storage and pipeline sizing for sources that produce variable CO₂ amounts.
- Began identifying journals for potential publication of the pipeline-sizing document.
- Identified CO₂ capture technologies that were not included in the value-added 2011 capture technology assessment document.
- Continued plans to attend the 2013 CO₂ Capture Technology Meeting scheduled for July 8–11, 2013, in Pittsburgh, Pennsylvania.

Task 7 – CO₂ Procurement (John A. Harju)

Highlights

- Participated in ongoing project discussions with Denbury.
- Continued planning for the procurement plan and agreement report (D48, due September 2013).

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

Highlights

- Investigated CO₂-monitoring techniques that could be used to measure the amount of CO₂ that leaks from the surface equipment at an injection site.
- Held an in-house meeting to discuss a draft outline for a report on measurement of CO₂ fugitive emissions at injection sites.
- Initiated a cursory literature review of injection-related documents.

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

Highlights

- Modeling staff participated in a 2-day workshop understanding the TOUGH2-EGS (Enhanced Geothermal Systems) simulator on June 3 and 4, 2013, at the Colorado School of Mines in Golden, Colorado.
- Modeling staff participated in a 2-day workshop on understanding and using the TOUGH2-CSM (Cabron Sequestration Modeling) simulator on June 5 and 6, 2013, at the Colorado School of Mines in Golden, Colorado.

- Modeling staff attended the ARMA (American Rock Mechanics Association) 47th U.S. Rock Mechanics/Geomechanics Symposium, as well as the 3rd Geomechanics Solutions for Environmental and Technical Challenges in Unconventional Resources Workshop, and the 2nd Workshop on Petroleum Geomechanics Testing in San Francisco, California, held June 27–30, 2013.
- Submitted M26 entitled “Bell Creek Test Site – CO₂ Injection Initiated” on June 26, 2013. Received DOE approval on June 27, 2013.
- Continued Bell Creek site activities, including the following:
 - Continued writing the Simulation Report, Update 2 (D66, due August 30, 2013).
 - Worked on issues arising during simulation.
 - Prepared a summary of prediction results and a summary of PVT (pressure-volume-temperature) model activity for Denbury.
 - Worked on prediction of CO₂ flooding: continuous injection and WAG (water-alternating-gas).
 - Prepared an overview of continuous CO₂ injection results.
- Continued Fort Nelson site activities, including the following:
 - Continued efforts to compile a report summarizing the activities and lessons learned at the Fort Nelson test site.
 - 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

- Submitted D57, the annual assessment report, on December 28, 2012.

Task 13 – Project Management (Charles D. Gorecki)

Highlights

- Traveled to the Bell Creek Field June 25–27, 2013, and participated in a safety walk-through for the start-up of production and received an overview of injection operations.
- Work continued on several poster abstracts for the DOE Carbon Storage R&D Project Review Meeting, covering the projects at Zama and Bell Creek, and the Basal Cambrian characterization and modeling activities.
- Discussed progress made with encouraging partners (existing and potential) from the utility sector to attend the PCOR Partnership Annual Membership Meeting.

- Participated in a conference call with DOE on June 17, 2013, regarding an onshore/offshore MVA meeting scheduled for August 19, 2013 (10:00 a.m. to 3:00 p.m.), with representatives from Norway. The PCOR Partnership program manager will give a 20-minute presentation on EOR activities (Bell Creek) and MVA in extreme climates (Fort Nelson and Zama).
- Attended the IEAGHG Combined Modelling and Risk Assessment Network Meeting in Trondheim, Norway, June 10–13, 2013.
- Held a brief monthly call with Spectra management on June 14, 2013.
- Participated in a conference call with BillyJack Consulting on June 13, 2013.
- Continued planning for the Dr. Deutsch geostatistics training scheduled to be held August 5–8, 2013, at the EERC.
- Continued planning for a TAB WebEx scheduled for August 23, 2013, to discuss the Basal Cambrian project.
- Conducted the monthly task leader meeting on June 4, 2013. Topics discussed included updates on the Bell Creek, Fort Nelson, Aquistore, and Basal Cambrian projects; review of upcoming conferences and deliverables; and updates from each task leader present.
- Continued planning for the upcoming PCOR Partnership Annual Membership Meeting scheduled for September 25–26, 2013, in Minneapolis, Minnesota, including preparation of a preliminary meeting agenda.
- Deliverables and milestones completed in June:
 - May monthly update
 - Task 3: M42 – Findings and Recommendations of the Operational and Postoperational Subgroups Presented to the CGS Task Force
 - Task 9: M26 – Bell Creek Test Site – CO₂ Injection Initiated
 - Task 14: M23 – Monthly Water Working Group (WWG) conference call held
 - Task 3: M37 – IOGCC Task Force Subgroup Meeting 2 Held

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

Highlights

- Continued work on the next WWG fact sheet (D99, due October 31, 2013) focused on water-monitoring technologies.
- Continued planning for the upcoming WWG annual meeting (scheduled for August 19, 2013, in Pittsburgh, Pennsylvania) including room setup, e-mail blasts, refreshments, and related items.
- Held the monthly conference call on June 27, 2013, and discussed updates to the fact sheet outline and progress of the plans for the upcoming WWG annual meeting.
- Distributed the May 30, 2013, conference call notes on June 26, 2013.
- Distributed a request for participation in the WWG open house to WWG members along with information on how to register for the DOE meeting poster session.

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

Highlights

- Continued drafting the Updated Regional Technology Implementation Plan for Zama (D86, due September 2013).

- Held an in-house project update meeting on June 20, 2013.
- Worked on designing cases for the G2G Pool history match.
- Worked on the G2G Pool simulation.
- Continued activities with regard to the Muskeg L Pool, including the following:
 - Began recalculating CO₂ storage values using derived temperature and pressure gradients.
 - Continued work on dataflow and tuned the model.

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

Highlights

- Continued in-house review and revisions on the report describing wellbore integrity (D90, due September 2013).
- Continued work on eight additional injection scenarios by varying the rock compressibility and injection strategies to maximum CO₂ injection based on the 25 selected locations.
- Continued review of two Alberta Innovates – Technology Futures reports (due June 28, 2013) on the Basal Aquifer Project.
- Continued preparing an abstract using the simulation data that have been performed on the Basal Cambrian.
- Exported the 3-D model into average maps for Princeton University personnel.
- With regard to the Aquistore project (20 core samples) mineralogical characterization:
 - Finished cleaning the salt from the samples using the Dean–Stark.
 - Began evaluation and description of the thin sections received back from Wagner Petrographics.
 - Continued thin-section analyses. Samples are in the humidity chamber, prepped for upcoming grain density and porosity measurements.
 - Began preparing core plugs for permeability and geomechanical testing.
 - EERC staff participated in a PTRC SERC (Science and Engineering Research Council) meeting held June 12, 2013.
 - Began planning for the next Aquistore Risk Assessment and SERC meeting scheduled for July 9–12, 2013, in Regina, Saskatchewan.

Travel/Meetings

- June 2–7, 2013: Participated in TOUGH2-EGS and TOUGH2-CSM workshops at the Colorado School of Mines in Golden, Colorado.
- June 8–14, 2013: Participated in the IEAGHG Combined Modelling and Risk Management Network Meeting in Trondheim, Norway.
- June 10–12, 2013: Presented at the Introduction to CO₂-EOR Workshop in Houston, Texas.
- June 10–14, 2013: Visited the Muddy Outcrop and area landowners near Hulett, Wyoming.
- June 11–14, 2013: Performed maintenance on equipment installed at the Bell Creek site.
- June 17–18, 2013: Presented at the 2013 Lignite Education Seminar: Energy, Economics, and Environment in Bismarck, North Dakota.
- June 18–21, 2013: Hosted and presented at the IOGCC CGS Task Force meeting held in Denver, Colorado.

- June 19, 2013: Inspected the Phase II Lignite Field Validation Test site near Kenmare, North Dakota.
- June 20–27, 2013: Attended the ARMA 47th U.S. Rock Mechanics/Geomechanics Symposium, as well as the 3rd Geomechanics Solutions for Environmental and Technical Challenges in Unconventional Resources Workshop, and the 2nd Workshop on Petroleum Geomechanics Testing in San Francisco, California.
- June 24–27, 2013: Conducted sampling work at the Bell Creek field near Gillette, Wyoming.
- June 25–26, 2013: Give a presentation entitled “Integrating Regional History, Culture, Science and the Arts” at the PPB Teacher Training Institute in Moorhead, Minnesota.
- June 25–27, 2013: Attended a meeting with Denbury personnel at the Bell Creek Field near Hulett, Wyoming.
- June 25–28, 2013: Met with area landowners and observed well pump installation at the Bell Creek Field near Gillette, Wyoming.

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