Plains CO_2 Reduction (PCOR) Partnership Monthly Update
April 1–30, 2017

PHASE III ACTIVITIES

Task 1 – Regional Characterization (Wesley D. Peck)

Highlights

- Worked on material for the update to the Bell Creek portion of the PCOR Partnership members-only Decision Support System (DSS).
- Submitted an abstract entitled "Geologic Storage of Carbon Dioxide in the Central Plains of North America" for consideration at the American Institute of Chemical Engineers (AIChE) Annual Meeting to be held October 29 – November 3, 2017, in Minneapolis, Minnesota.
- Worked on a draft glossy executive summary for the PCOR Partnership program.
- Worked on a structure/extent model of the Cedar Hills Formation and recalculated potential storage capacity.
- Continued activities to update the content of the **PCOR Partnership general database**, including the following:
  - Updated North Dakota, Montana, Wyoming, and Saskatchewan well information.
  - Updated North Dakota injection data.
  - Continued database preventive maintenance of Petra projects.
- With regard to **Williston Basin** CO_2 Storage Sink Relative Permeability Laboratory Characterization:
  - Continued internal review of the draft value-added report.
- With regard to the **Aquistore** project's static modeling and dynamic predictive simulations effort:
  - Continued to download and process injection and pressure data as available. Data through April 24, 2017, have been provided.
  - No Science and Engineering Research Committee (SERC) conference calls were held in April 2017.
  - Awaiting signatures regarding new contracting agreement regarding data sharing and Energy & Environmental Research Center (EERC)–Petroleum Technology Research Centre (PTRC) relationship with respect to modeling.

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

Highlights

- The broadcast premiere for Documentary D21 (*The Bell Creek Story – CO_2 in Action*) is scheduled for June 19, 2017, at 7:00 PM CDT on Prairie Public Broadcasting (PPB) stations.

- Received approval for the value-added "Household Energy and Carbon Web Pages Report" for the October 1 – December 31, 2016, quarter on April 5, 2017.
- Submitted the value-added "Household Energy and Carbon Web Pages Report" for the January 1 – March 31, 2017, quarter on April 28, 2017.
- Continued work related to Documentary D21 (*The Bell Creek Story – CO_2 in Action*), including the following:
  - Finalized the DVD components. Submitted artwork and DVD content to the printer, RelyMedia, for reproduction on April 28, 2017.
  - Continued work on the video clip and Web page components.
  - Work began on the PPB promotional spots for the documentary.
- Initiated work on D17 – General Phase III Information PowerPoint Presentation (update), including updated information on slides containing CO_2 sequestration projects and outreach materials.
- Initiated work on the revisions for the presentation and materials for the Lignite Energy Council Teacher Seminar to be held in June 2017. Revisions included updating the project map.
- Continued the internal review/revision process for the draft value-added update of the Phase II Terrestrial Sequestration fact sheet.
- Participated in the monthly Outreach Working Group (OWG) conference call on April 20, 2017.
- Continued to write content for CarbonSAFE (Carbon Storage Assurance and Facility Enterprise) project pages to be added to the CO_2 Sequestration Projects section of the public Web site in a future update. Continued to work on changes to the CO_2 Projects Map image to include these projects.
- Continued work on the PCOR Partnership public Web site, including the following:
  - Fixed and reviewed broken Web site links. They are now live.
  - Separated the "PCOR Partnership Atlas 5th Edition" (D81) PDF version into chapters for easier download. Uploaded the "PCOR Partnership Atlas 5th Edition" PDF version. Related updates were made on the Home, Atlas, and Request Information pages.
  - Created mockup Web pages for a new Bell Creek documentary page and the Documentaries landing page.
  - Began work on content for a CO_2 storage feasibility study page related to the Red Trail Energy, LLC, ethanol facility.

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

Highlights

- Prepared for the International Oil and Gas Compact Commission (IOGCC) Annual Business Meeting, which will be held May 7–9, 2017, in Oklahoma City, Oklahoma. A Task 3 representative will represent North Dakota as the Vice Chairman of the Environment and Safety Committee.

Task 4 – Site Characterization and Modeling (Charles D. Gorecki)

This task ended in Quarter 1 – Budget Period (BP) 5, Year 10 (March 2017).

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

- Worked on the 2017 D85 update (Opportunities and Challenges Associated with CO_2 Compression and Transportation During Carbon Capture Utilization and Storage [CCUS] Activities), including the following:
  - Performed additional Web-based research on CO_2 purification requirements for pipelines, corrosion potential of O_2 in the pipe, etc.
  - Wrote text for the "Industrial Sources of CO_2 and Their Most Common Impurities" section. Industries to be featured in the section include power plants, cement plants, ethanol plants, petroleum refineries, and gas-processing plants.
  - Wrote text related to the most common impurities found in some industrial sources of CO_2.
  - Wrote text related to the applicability of nonsteel pipe for CO_2 transport.

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)

This task ended in Quarter 4 – BP4, Year 8 (September 2015).

Task 9 – Operational Monitoring and Modeling (John A. Hamling and Larry J. Pekot)

Highlights

- Continued working on content for the modeling and simulation best practices manual (BPM) (D69), included the following:
  - Prepared the draft outline.
  - Wrote text for the initial sections.
  - Wrote text for the modeling and simulation sections, including case studies.
- Continued work on the BPM – Monitoring for CO_2 Storage and CO_2 EOR (enhanced oil recovery) (D51), including writing and revising the draft outline, determining reference resources, and developing the BPM approach.
- Worked on a risk assessment manuscript suitable for a peer-reviewed journal.
- **Bell Creek** injection-phase site activities included the following:
  - Continued reservoir pressure and distributed temperature monitoring of 05-06 OW (observation well) from the permanent downhole monitoring system using the casing-conveyed pressure–temperature gauges and fiber-optic distributed temperature system:
    - Near-continuous operation since April 2012.

- Continued dynamic reservoir pressure and multiphase fluid flow simulation efforts. The modeling and simulation focus remains on Bell Creek Field Phase Areas 1–4. Accomplishments and activities include the following:
  - History matching of the simulation model is complete for Bell Creek Phase Areas 1–3. Predictive simulation is complete for Bell Creek Phase Areas 1 and 2. Long-term simulations of CO_2 migration are complete for Bell Creek Phase Areas 3–7.
  - History matching of the simulation model is complete for the waterflooding and CO_2-flooding stages for Bell Creek Phase Area 4 using the Version 3 simulation model.
  - Tested a simulation case with induced fractures.
- Continued work on D104 (Analysis of Expanded Seismic Campaign), including the following:
  - Wrote text for the surface seismic data acquisition and processing section. Created figures and edited text for the Acquisition and Processing section.
  - Wrote text for the 4-D seismic amplitude interpretation section.
  - Continued figure development.
- Continued 4-D seismic data analysis and interpretation, including the following:
  - Completed prestack inversions of angle-gather stacks (near, mid, and far). Generated slices (maps) of inverted volumes over the reservoir.
- Continued Bell Creek Field microseismic data processing focused on data collected May–June 2013 and June–July 2014, including the following:
  - Conducted ray tracing modeling to validate string shots and to improve velocity model used in data processing.
- Continued work with pulsed-neutron logging data in the Techlog project.
- Continued with a hysteresis study to inform Version 3 simulation model parameters, including the following:
  - Performed laboratory tests on the second study sample. Determined CO_2 permeability, brine permeability, oil permeability, and hysteresis.
  - Worked on data processing in order to provide data for the simulation model.
- Used the most recent publicly available data to determine that cumulative total CO_2 gas injection is 6,896,297 tonnes through February 28, 2017. This value represents the total gas amount injected, which includes purchase and recycle streams and is NOT corrected for a gas composition of approximately 98% CO_2 (Table 1).

Table 1. Bell Creek CO_2 Gas Injection Totals for February 2017 (cumulative totals May 2013 to February 2017)[1]

	February 2017 Injection
Total, Mscf	3,480,756
Total, tons[2]	199,094
Total, tonnes[3]	180,790
Cumulative Total, Mscf	132,774,397
Cumulative Total, tons[2,4]	7,594,486
Cumulative Total, tonnes[3,4]	6,896,297

Source: Montana Board of Oil and Gas database.

[1] Total gas injection quantities are ***NOT CORRECTED*** for gas composition and include the combined purchased and recycled gas streams.

[2] Calculated utilizing a conversion of 17.483 Mscf/ton.

[3] Calculated utilizing a conversion of 19.253 Mscf/tonnes.

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

- As of February 28, 2017, the most recent month of record, 3.712 million tonnes of total gas (composition of approximately 98% CO_2) has been purchased for injection into the Bell Creek Field, equating to an estimated 3.654 million tonnes of CO_2 stored (Table 2), with the difference comprising other trace gases in the purchase gas stream. A separate methodology from that used to calculate total gas injected was used to calculate a cumulative associated CO_2 storage volume estimate by correcting the gas purchase volume (approximately 98% CO_2) obtained from Denbury Onshore's (Denbury's) custody transfer meter with gas compositional data.
- Worked with Denbury personnel on the initiation of the sixth round of oil sample collection from a select group of wells in the Bell Creek Field.
- Continued work on data processing of oil composition and "miscible" phase analyses.
- A summary of all oil and CO_2 gas stream samples collected for analyses to date is provided in Table 3.

Table 2. Cumulative Total Gas Purchased and Estimated Associated CO_2 Storage for the Bell Creek Field[1]

	February 2017 Gas Totals
Monthly Total Gas Purchased, MMscf[2]	1261
Monthly Total Gas Purchased, million tons[2]	0.072
Monthly Total Gas Purchased, million tonnes[2]	0.066
Cumulative Total Gas Purchased, MMscf[2,3]	71,464
Cumulative Total Gas Purchased, million tons[2,3]	4.088
Cumulative Total Gas Purchased, million tonnes[2,3]	3.712
Cumulative Total CO_2 Stored, MMscf[3,4]	70,351
Cumulative Total CO_2 Stored, million tons[3,4]	4.024
Cumulative Total CO_2 Stored, million tonnes[3,4]	3.654

[1] Conversion factors of 17.483 Mscf/ton and 19.253 Mscf/tonne were used to calculate equivalent purchase and storage quantities.
[2] Total gas purchased *NOT CORRECTED* for gas composition.
[3] Cumulative totals are for the period from May 2013 to the month listed.
[4] Total CO_2 stored *CORRECTED* for gas composition.

Table 3. Oil and CO_2 Gas Stream Sampling and Analyses

Date Sampled	Purchase/ Recycle[1]	Production Stream by Development Phase, Well[1]									
		Phase 1				Phase 3			Phase 4		
		56-14R	32-02	05-06	04-04	28-02	21-10	21-14	34-09	34-07	34-03
Jan 2014		O	O	O							
Mar 2014		O	O								
May 2014	P	O	O	O							
Jun 2014	PR	O	O	O							
Jul 2014	PR	O	O	O							
Sep 2014	PR	OG	OG	O							
Oct 2014	PR	O	O								
Nov/Dec 2014		OG	OG	G							
Jan 2015			O	OG							
Mar 2015		G	G	G							
Apr 2015	PR										
Jun 2015		O	O	O							
Jul 2015	PR	G	G	G							
Sep 2015	PR										
Nov 2015		O		O							
Jan 2016	PR										
Apr/May 2016		O	O	O	O	O	O	O			
Jun/Jul 2016	PR	O		O	O	O	O	O			
Aug/Sep 2016		O	O		O	O	O	O	O		
Oct 2016				O							
Nov/Dec 2016[2]	PR	O	O	O	O	O	O	O	O	O	O
Feb 2017[2]		O	O		O	O	O	O	O	O	O

[1] P = purchase CO_2 gas stream, R = recycle CO_2 gas stream, O = produced oil stream, and G = produced CO_2 gas stream.
[2] Oil samples collected but not yet analyzed.

Task 10 – Site Closure (John A. Hamling)

Highlights

- Nothing to note at this time.

Task 11 – Postinjection Monitoring and Modeling (John A. Hamling and Larry J. Pekot)

Highlights

- Nothing to note at this time.

Task 12 – Project Assessment (Loreal V. Heebink)

Highlights

- Nothing to note at this time.

Task 13 – Project Management (Charles D. Gorecki)

Highlights

- Attended the CCUS Conference held April 10–13, 2017. Participated in the "Making History – Major CCUS Projects in the U.S." panel discussion. Presented "The Plains CO_2 Reduction Partnership: CO_2 Injection Update and Results of Adaptive Management Approach."
- Presented "An Adaptive Management Approach for Monitoring CO_2 Storage" as a representative of the U.S.–Taiwan Carbon Capture and Storage (CCS) Delegation to Taipei April 17–21, 2017, in Taipei, Taiwan. The presentation contained some lessons learned through the PCOR Partnership. Showed a viewing of the draft version of *The Bell Creek Story – CO_2 in Action* documentary (D21).
- Attended the Carbon Sequestration Leadership Forum Mid-Year Meeting, held April 30 – May 3, 2017, in Abu Dhabi, United Arab Emirates (UAE).
- Submitted an abstract entitled "The Plains CO_2 Reduction (PCOR) Partnership: Successes Leading to New Innovation" for consideration at the EAGE Near Surface Geoscience 2017 to be held September 3–7, 2017, in Malmö, Sweden.
- Submitted an abstract entitled "Demonstration of Secure CO_2 Geological Storage Associated with Enhanced Oil Recovery in the PCOR Partnership Region" for consideration at the Carbon Management Technology Conference (CMTC) 2017 to be held July 17–20, 2017, in Houston, Texas.
- Continued addressing reviewer comments on the revised Adaptive Management Approach BPM (D102).
- Worked on a planned special issue of the *International Journal of Greenhouse Gas Control* focused on Bell Creek activities, including compiling a list of articles and working on a management plan.
- Continued planning for the PCOR Partnership annual membership meeting, including:
  - Chose Plano, Texas, as the new venue with dates of October 24–26, 2017.
  - Negotiated with a hotel in Plano, Texas.
  - Held a planning meeting to discuss potential speakers, potential special event sponsors, Pioneer Award recipients, and workshop ideas.
- Continued planning the 2017 Technical Advisory Board (TAB) meeting to be held May 23–24, 2017, in San Francisco, California, including:
  - Contacted TAB members.
  - Finalized agenda.
  - Worked on arrangements with the hotel.
  - Worked on evening event arrangements.
- Held a task leader meeting April 4, 2017. Topics discussed included discussion of the PCOR Partnership BPMs, planning for the 2017 annual TAB and PCOR Partnership annual meetings, Bell Creek project updates, upcoming conferences, and task leader updates.
- Completed deliverables and milestones in April:
  - March monthly update
  - Task 13: D58/D59 – Quarterly Progress Report/Milestone Quarterly Report

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

Highlights

- Continued work on D107 (Journal Article or Topical Report – Major Research Focuses for Water and CCS), including the following:
  - Created detailed outlines for each report section.
- Created an outline and wrote draft introduction for D101 – WWG Web Site Content Update.

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

- April 3–7, 2017: off-site staff traveled to Grand Forks, North Dakota, to work on-site at the EERC on various projects.
- April 10–13, 2017: traveled to Chicago, Illinois, to present at and participate in the Carbon Capture Utilization and Storage conference.
- April 17–21, 2017: traveled to Taipai, Taiwan, to attend the U.S.–Taiwan International Carbon Capture & Sequestration Conference.
- April 18–19, 2017: traveled to Bismarck, North Dakota, to attend the Lignite Energy Council Annual Meeting.
- April 27 – May 4, 2017: traveled to Abu Dhabi, UAE, to attend the Carbon Sequestration Leadership Forum 2017 Mid-Year Meeting.

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