



Plains CO₂ Reduction (PCOR) Partnership Monthly Update March 1–31, 2018

PHASE III ACTIVITIES

Task 1 – Regional Characterization (Wesley D. Peck)

Highlights

- Continued activities to update the content of the **PCOR Partnership partners-only Decision Support System (DSS) Web site**, including the following:
 - Completed programming efforts for the Bell Creek section of the PCOR Partnership members-only DSS Web site. The Bell Creek section under Demonstration Projects is now live.
- Continued work on integrating data for modeling and simulation efforts related to CO₂ storage in mature and depleted oil fields within the region, including the following:
 - Ran a few cases of void replacement (VREP) ratio estimation for the Beaver Creek Field using four (fewer) wells to inject CO₂ instead of all wells that produced over the life of the field, analyzed the results, and updated the summary.
 - Completed the history match of oil, gas, and water production data for the Gooseneck Field. Ran cases with different CO₂ injection pressures to investigate the VREP for the Gooseneck Field.
- Continued internal review of a value-added report on the geologic characterization and CO₂ storage potential of the state of Nebraska.
- Continued internal review of a value-added report on Williston Basin CO₂ storage sink relative permeability laboratory characterization activities.
- With regard to the **Aquistore** project's static modeling and dynamic predictive simulations effort:
 - Participated in a Science and Engineering Research Committee (SERC) conference call March 7, 2018. Injection continues at Aquistore at rates ranging from 350 to 450 tonnes per day. A modeling workshop is being planned for April 5, 2018, in Regina, Saskatchewan.

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

Highlights

- The broadcast premiere of *Coal: Engine of Change* (Documentary Deliverable [D] 22) was March 27, 2018, at 7:00 P.M. CDT on Prairie Public Broadcasting (PPB) stations.
- Continued work related to Documentary D22, including the following:
 - Submitted captioning edits to the captioner.
 - Continued work on the preparation of draft final content for the DVD jacket and insert text.

- Continued collaborative efforts with PPB, including the following with regard to Documentary D22:
 - Completed editing and captioning activities.
 - Worked on promotional script, b-roll, and description for publicity to PPB.
 - Continued to prepare materials for the video library clips and sent notes to PPB.
 - Prepared DVD menus and sent to PPB.
- Continued internal discussions and work on the planned public PCOR Partnership public Web site technical upgrade design, including the following:
 - Continued to discuss progress and needs of programming.
 - Worked on and reviewed text updates for the following pages:
 - ♦ Basal Cambrian regional project
 - ♦ Options to Reduce CO₂
 - ♦ CO₂ Sources and Emissions
 - ♦ Geologic Potential
 - ♦ Regulations and Permitting
 - ♦ Climate Change
 - ♦ Greenhouse Effect
 - ♦ Anthropogenic CO₂
 - ♦ Enhanced Oil Recovery (EOR)
 - Reviewed draft changes to all updated sections.
 - Completed preparations of new thumbnails for Video Clip Library and individual Web pages. Prepared title images for older video clips.
- The following Web pages went live on the PCOR Partnership public Web site in conjunction with the Documentary D22 premiere:
 - The Coal and Documentaries Web pages went live March 26, 2018, in advance of the premiere. These pages included all changes except the full-length documentary.
 - The Coal, Documentaries, and Home Web pages went live March 28, 2018, following the premiere, including the full-length documentary.
- Continued writing a draft outreach paper for 14th Conference for Greenhouse Gas Control Technologies (GHGT-14).

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

Highlights

- Nothing to note at this time.

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

- Completed preparation of the update of the final version of the CO₂ capture technologies overview value-added document, which will summarize trends in CO₂ capture. Worked on internal review.

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)

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

- Presented “Regional Update of CCUS Field Projects within the PCOR Partnership Region: Improving the Commercial Viability of CO₂ Storage through Improved Performance Monitoring and Operational Management” at the CCUS (Carbon Capture, Utilization, and Storage) Conference held March 20–22, 2018, in Nashville, Tennessee.
- Based on mutual agreement with the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) Project Manager, the PCOR Partnership submitted updates to two best practices manuals that incorporate additional technical expert reviewer perspectives and findings, as follows:
 - D69 entitled “Best Practices for Modeling and Simulation of CO₂ Storage” was originally submitted May 31, 2017. Submitted a revised version for review on March 12, 2018, and received approval March 14, 2018.
 - D51 entitled “Best Practices Manual – Monitoring for CO₂ Storage” was originally submitted October 31, 2017. Submitted a revised version for review on March 9, 2018. Received approval on March 13, 2018, with DOE comments. Submitted the finalized revised version incorporating DOE comments on March 29, 2018.
- Received all client reviews of and continued modifications to papers for the planned special issue of *International Journal of Greenhouse Gas Control* (IJGGC).
- Continued writing draft GHGT-14 papers.
- Continued discussions of plans to upload PCOR Partnership data to NETL’s Energy Data eXchange (EDX) and a pathway for long-term data management.
- Worked on compiling information for a knowledge-sharing workshop with Denbury Onshore (Denbury) in May 2018.
- Completed a draft manuscript entitled “Lab and Reservoir Study of Produced Hydrocarbon Molecular Weight Selectivity during CO₂ Enhanced Oil Recovery” to be submitted to a journal such as *Energy & Fuels*. Provided to Denbury for initial review.
- **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 processing microseismic events in the Bell Creek Field.
- Revised the model to match the simulated surface deformation and the InSAR (interferometric synthetic aperture radar) surface deformation.
- Continued to apply interpretation workflow to newly processed vertical seismic profile baseline data.
- Used the most recent publicly available data to determine that cumulative CO₂ gas injection is 9,636,651 tonnes through January 31, 2018. This value represents the total gas injected, which includes purchase and recycle streams and is NOT corrected for a gas composition of approximately 98% CO₂ (Table 1).
- As of December 31, 2017, the most recent month of record, 4.803 million tonnes of total gas (composition of approximately 98% CO₂) has been purchased for injection into the Bell Creek Field, equating to an estimated 4.739 million tonnes of CO₂ stored (Table 2), with the difference comprising other trace gases in the purchase gas stream. A separate

Table 1. Bell Creek CO₂ Gas Injection Totals for January 2018 (cumulative totals May 2013 to January 2018)¹

	January 2018 Injection
Total, Mscf	6,450,305
Total, tons ²	368,947
Total, tonnes ³	335,029
Cumulative Total, Mscf ⁴	185,534,444
Cumulative Total, tons ^{2,4}	10,612,277
Cumulative Total, tonnes ^{3,4}	9,636,651

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/tonne.

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

Table 2. Cumulative Total Gas Purchased and Estimated Associated CO₂ Storage for the Bell Creek Field¹

	December 2017 Gas Totals
Monthly Total Gas Purchased, MMscf ²	3929
Monthly Total Gas Purchased, million tons ²	0.225
Monthly Total Gas Purchased, million tonnes ²	0.204
Cumulative Total Gas Purchased, MMscf ^{2,3}	92,474
Cumulative Total Gas Purchased, million tons ^{2,3}	5.289
Cumulative Total Gas Purchased, million tonnes ^{2,3}	4.803
Cumulative Total CO ₂ Stored, MMscf ^{3,4}	91,238
Cumulative Total CO ₂ Stored, million tons ^{3,4}	5.219
Cumulative Total CO ₂ Stored, million tonnes ^{3,4}	4.739

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 CO₂ stored **CORRECTED** for gas composition.

method from that used to calculate estimated total gas injected was used to calculate a cumulative associated CO₂ storage by correcting the gas purchase volume (approximately 98% CO₂) obtained from Denbury's custody transfer meter with gas compositional data.

- A summary of all oil and CO₂ gas stream samples collected for analyses to date is provided in Table 3.
- Completed sensitivity analysis, focused on the low-pressure side, on a PVT (pressure, volume, temperature) model for asphaltene deposition of the Bell Creek oil based on experimental and field monitoring data. Integrated the asphaltene deposition PVT model into the Peng–Robinson equation of state model, which will be used for reservoir simulation and prediction of asphaltene deposition behavior in the field.

Task 10 – Site Closure (John A. Hamling)

Highlights

- Held a conference call with Denbury representatives to discuss handoff of the 05-05 OW permanent downhole monitoring (PDM) system. A PCOR Partnership representative is scheduled to travel to the Bell Creek Field April 4–6, 2018, to download data from the PDM system, train a Denbury representative on operation of the system, and perform the handoff to Denbury, the site operator.

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

Highlights

- Worked on compiling information for a knowledge-sharing workshop with Denbury in May 2018.

Task 12 – Project Assessment (Loreal V. Heebink)

Highlights

- Nothing to note at this time.

Task 13 – Project Management (Charles D. Gorecki)

Highlights

- Scout Energy Management LLC has joined the PCOR Partnership as a paying member.
- The PCOR Partnership Project Manager presented “Plains CO₂ Reduction Partnership (PCOR)” at the Southeast Regional Carbon Sequestration Partnership (SECARB) 13th Annual Meeting held March 7–8, 2018, in Atlanta, Georgia.
- The PCOR Partnership Project Manager attended the GLOBE Forum 2018 – Carbon Capture, Utilization, and Storage Technology Cluster held March 14–16, 2018, in Vancouver, British Columbia.
- Submitted Milestone (M) 66 entitled “Submission of Draft Papers on Associated Storage to Special Issue of IJGGC” on March 29, 2018, and was approved March 30, 2018.
- Submitted the quarterly international activity update on March 20, 2018.
- Continued editing papers submitted for a planned special issue of IJGGC. Identified additional candidate reviewers.
- Continued work on internal reviews of draft papers for GHGT-14.

Table 3. Oil and CO₂ 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	34-05	35-03	35-13	34-01	35-11
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					
May 2017 ²	PR	O	O	O	O	O	O	O	O	O	O					
Jul 2017 ²		O			O	O	O	O	O	O	O		O	O		
Oct 2017				O			O	O	O	O	O	O	O	O	O	O
Nov 2017		O	O		O	O										
Dec 2017		O	O		O	O	O	O		O			O	O	O	O
Jan 2018									O			O				

¹ P = purchase CO₂ gas stream, R = recycle CO₂ gas stream, O = produced oil stream, and G = produced CO₂ gas stream.

² Oil samples collected but not yet analyzed.

- Continued work on D62 – Final Report.
- Continued planning for the PCOR Partnership Technical Advisory Board (TAB) annual meeting to be held April 9–11, 2018, in Miami, Florida. Worked with the hotel hosting the meeting. Finalized the agenda. Continued preparation of presentation materials.
- Continued planning for the 2018 PCOR Partnership Annual Membership Meeting. Traveled to Washington, D.C., March 22–23, 2018, for a site visit. Held a planning meeting on March 27, 2018, to discuss the site visit to Washington, D.C.
- Held a task leader meeting March 9, 2018. The focus of discussion was activities leading to the closeout of PCOR Partnership Phase III, including final task activities, deliverables, journal articles, conference papers, best practice manuals, site closure, and data management and transfer. Additionally, upcoming conferences and meetings, including the 2018 TAB meeting and the 2018 PCOR Partnership Annual Membership Meeting, were discussed.
- Tasks 1, 3, 6, 9, 11, and 14 are closed as of March 31, 2018. Any further efforts in these areas will be handled in the remaining open Tasks 2, 10, and 13.
- Completed reporting in March:
 - February monthly update
 - Task 13: M66 – Submission of Draft Papers on Associated Storage to Special Issue of IJGGC

Task 14 – Regional Carbon Sequestration Partnerships (RCSP) WWG Coordination (Ryan J. Klapperich)

Highlights

- Received approval for D107 entitled “Nexus of Water and CCS [Carbon Capture and Storage]: Findings of the Water Working Group (WWG) of the Regional Carbon Sequestration Partnerships” on March 1, 2018. This deliverable will also serve as a GHGT-14 paper upon acceptance from the conference.
- Distributed the notes from the February 6, 2018, quarterly conference call.

Task 15 – Further Characterization of the Zama Acid Gas EOR, CO₂ 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

- March 7–8, 2018: traveled to Atlanta, Georgia, to present at the Annual SECARB Meeting.
- March 14–16, 2018: traveled to Vancouver, British Columbia, to attend the GLOBE Forum: Leadership Summit for Sustainable Business.
- March 18–22, 2018: traveled to Nashville, Tennessee, to attend the 2018 CCUS Conference.
- March 22–23, 2018: traveled to Washington, D.C., for a site visit to determine possible venues for the 2018 PCOR Partnership Annual Membership Meeting.

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