Plains CO_2 Reduction (PCOR) Partnership Monthly Update
February 1–28, 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:
  - Discussed the Bell Creek section of the PCOR Partnership members-only DSS following completion of internal review and determined action items.
- Continued work on integrating data for modeling and simulation efforts related to CO_2 storage in mature and depleted oil fields within the region, including the following:
  - Completed the Lodgepole static model, including temperature and pressure properties.
  - Continued to improve history match for oil, water, and gas production data and gas/oil ratio for the Gooseneck Field. Worked on running history-matching cases with different bottomhole pressure and rock compressibility to improve the match for gas production data.
  - Obtained a good history match on all three types of fluid production data for the Beaver Creek Field. Completed simulation work on the estimation of voidage replacement ratio by CO_2 storage after calibrating the simulation model with the field history data. Started to revise Beaver Creek Field simulations, converting just the best few producers to injectors instead of all producers.
- With regard to **Williston Basin** CO_2 storage sink relative permeability laboratory characterization:
  - Worked on additional internal review of the value-added report.
- With regard to the **Aquistore** project's static modeling and dynamic predictive simulations effort:
  - Downloaded and processed injection and pressure data through January 2018.

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

Highlights

- With regard to **Documentary Deliverable (D) 22**:
  - Traveled to Fargo, North Dakota, on February 5 and 14, 2018, to meet with Prairie Public Broadcasting (PPB) about Documentary D22. Activities included production of the final narration track, a final review of the draft Documentary D22, and development of a plan to meet a scheduled broadcast on March 27, 2018, at 7:00 p.m. in the PPB viewing area. Several iterations of an updated draft version were received from PPB, reviewed, and changes were sent back to PPB.

  - Selected a final title of "Coal: Engine of Change."
  - Continued work on promotional content, including DVD jacket text and images, definition of video clips for the PCOR Partnership Web site, and draft marketing language for the broadcast premiere.
- Continued internal discussions and work on the planned public PCOR Partnership public Web site technical upgrade design, including the following:
  - Selected a new header image and page colors.
  - Worked on text updates for the following pages:
    - Home page
    - About the Partnership
    - Meet the Team
    - PCOR Partnership Partners
    - Informational Resources
    - Technical Publications
    - FAQ page
    - Links page
    - Regional Storage Potential section
  - Discussed progress and needs of programming.
  - Continued preparations of new thumbnails for Video Clip Library and individual Web pages.

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

Highlights

- Submitted for review and received approval for D8 entitled "Permitting Review – Update 4" on February 23, 2018.
- Responded to a request from the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) regarding pore space and mineral rights.

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

- Continued preparation of the update of the final version of the CO_2 capture technologies overview value-added document.

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

- Traveled to Plano, Texas, to meet with Denbury Onshore (Denbury) representatives on February 23, 2018. Discussed Bell Creek engagement, review process with priority of *International Journal of Greenhouse Gas Control* (IJGGC) papers and deliverables, final invoicing, data sharing, and scheduling of a knowledge-sharing workshop in Dallas, Texas, in May 2018.
- Based on mutual agreement with the DOE NETL Project Manager, the PCOR Partnership plans to submit an update to D69 (Best Practices for Modeling and Simulation of CO_2 Storage), which was submitted May 31, 2017, and to D51 (Best Practices Manual – Monitoring for CO_2 Storage), which was submitted October 31, 2017, that incorporate additional technical expert reviewer perspectives and findings. Continued internal review and modifications to figures and text.
- Continued work on writing papers for the planned special issue of IJGGC.
- Continued discussions of plans to upload PCOR Partnership data to NETL's Energy Data eXchange (EDX) and a pathway for long-term data management.
- **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 the passive seismic data set.
  - Continued working on the InSAR (interferometric synthetic aperture radar) surface deformation data and the reservoir pressure data, improving the geomechanical modeling to match the results. Compared InSAR surface deformation results to the simulated surface deformation based on pore pressure change and geomechanical modeling.
  - Continued investigating influence of geology (as represented by geomodel) on rates/slopes of deformation. Comparing recent time-lapse data with InSAR maps.
  - Applied interpretation workflow to newly processed vertical seismic profile baseline data.
  - Used the most recent publicly available data to determine that cumulative CO_2 gas injection is 8,988,869 tonnes through November 30, 2017. This value represents the total gas injected, which includes purchase and recycle streams and is NOT corrected for a gas composition of approximately 98% CO_2 (Table 1).
  - As of December 31, 2017, the most recent month of record, 4.803 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 4.739 million tonnes of CO_2 stored (Table 2), with the difference comprising other trace gases in the purchase gas stream. A separate method from that used to calculate estimated total gas injected was used to calculate a cumulative associated CO_2 storage by correcting the gas purchase volume (approximately 98% CO_2) obtained from Denbury's custody transfer meter with gas compositional data.
  - A summary of all oil and CO_2 gas stream samples collected for analyses to date is provided in Table 3.

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

	November 2017 Injection
Total, Mscf	5,381,696
Total, tons[2]	307,828
Total, tonnes[3]	279,525
Cumulative Total, Mscf[4]	173,062,702
Cumulative Total, tons[2,4]	9,898,913
Cumulative Total, tonnes[3,4]	8,988,869

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 CO_2 Storage for the Bell Creek Field[1]

	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 CO_2 stored *CORRECTED* for gas composition.

- Worked on completing data analyses and continuing interpretation of field-collected oil samples and laboratory CO_2 pressure/crude oil mobilization studies. Worked on preparation of an initial journal manuscript.
- Worked on development of a PVT (pressure, volume, temperature) model for asphaltene deposition of the Bell Creek oil based on experimental and field monitoring data.

Table 3. Oil and CO_2 Gas Stream Sampling and Analyses

		Production Stream by Development Phase, Well[1]														
		Phase 1				Phase 3			Phase 4							
Date Sampled	Purchase/ Recycle[1]	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 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

- Discussed the field-activity transition plan with Denbury representatives during a meeting in Plano, Texas, on February 23, 2018.

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

- Continued writing papers and performing internal review of papers for a planned special issue of IJGGC. Began editing papers submitted.
- Worked on internal reviews of draft papers for the 14th Conference for Greenhouse Gas Control Technologies (GHGT-14).
- Worked on D62 – Final Report.
- Received a fully executed hotel contract for the PCOR Partnership Technical Advisory Board (TAB) annual meeting to be held April 9–11, 2018, in Miami, Florida.
- Continued discussions on the timing and location for the 2018 PCOR Partnership Annual Membership Meeting. Received information from several hotels and narrowed the list to two for consideration in Washington, D.C., in September or October 2018.
- Completed reporting in February:
  - January monthly update
  - Task 3: D8 – Permitting Review – Update 4
  - Task 14: D107 – Nexus of Water and CCS [Carbon Capture and Storage]: Findings of the Water Working Group (WWG) of the Regional Carbon Sequestration Partnerships

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

Highlights

- Held the quarterly conference call for February 6, 2018. This was the last conference call for this project effort. The focus was reviewing comments regarding the WWG GHGT-14 draft paper/final deliverable (D107), discussing the status of early WWG deliverables (white paper, etc.), and concluding WWG activities.
- Submitted D107 entitled "Nexus of Water and CCS: Findings of the Water Working Group (WWG) of the Regional Carbon Sequestration Partnerships" on February 28, 2018. This deliverable will also serve as a GHGT-14 paper upon acceptance from the conference.

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

- February 5, 2018: traveled to Fargo, North Dakota, to work on postproduction for the PCOR Partnership coal documentary with PPB.
- February 12–16, 2018: off-site staff member traveled to the Energy & Environmental Research Center (EERC) to attend meetings and work on specific projects.
- February 14, 2018: traveled to Fargo, North Dakota, to work on the final version of the PCOR Partnership coal documentary with PPB.
- February 22–23, 2018: traveled to Plano, Texas, for a meeting with Denbury.

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