SECARB Anthropogenic Test Update

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Presentation Outline

1. Project Introduction
2. Status
3. 2016-17 Monitoring Results
4. Project Closeout
Project Goals and Objectives

1. Support the United States’ largest (at the time) prototype CO\textsubscript{2} capture and transportation demonstration, with injection, monitoring and storage activities;
2. Test the CO\textsubscript{2} flow, trapping and storage mechanisms of the Paluxy;
3. Demonstrate how a saline reservoir’s architecture can be used to maximize CO\textsubscript{2} storage and minimize the areal extent of the CO\textsubscript{2} plume;
4. Test the adaptation of commercially available oil field tools and techniques for monitoring CO\textsubscript{2} storage;
5. Test experimental CO\textsubscript{2} monitoring activities, where such technologies hold promise for future commercialization;
6. Begin to understand the coordination required to successfully integrate all four components (capture, transport, injection and monitoring) of the project; and
7. Document the permitting process for all aspects of a CCS project.
Storage Site: The Citronelle Oilfield

Structure map and cross section by GSA
Project Status
Storage Project Status

- Injection commenced on August 20, 2012; ended September 1, 2014
- 114,104 metric tons of CO$_2$ injection
- Entered the three year Post-Injection Site Care Period on September 1, 2014
- Workover of the D-9-8#2 monitoring well resulted in a failed fishing operation and subsequent plugging and abandonment
- Post-injection time-lapse VSP acquired in January 2017
- Testing and monitoring results indicate containment
CO₂ Injection History

- **September 1, 2014**: Cumulative injection = 114,014 metric tons
- **October 29, 2013**: 100,000 metric tons of CO₂ injected
- **June 2014**: Injection well workover
- **August 20, 2012**: Injection operations begin
2016 D-9-8#2 Workover: The Plan

The purpose for the workover was to prepare the D-9-8#2 monitoring well for a post-injection time-lapse cross well seismic survey (receiver well). To do so the monitoring tool string had to be removed.

The scope of the workover included:

– Pulling the monitoring tool (MBM) assembly, tubing and packer
– Spool the MBM and geophone cables
– Set a bridge plug above the perforations
– Re-purpose the tubing, if salvageable

The pull was originally planned to take four days
Deployment of the Modular Borehole Monitoring (MBM) Conventional geophone array (left) and yellow flat pack containing the fiber optic based DAS array (right)

The D-9-8#2 Modular Borehole Monitoring System*

* The MBM was designed by LBNL under support from the CCP
2016 D-9-8#2 Workover Outcome

• Tubing packer could not be released
• After a series of tubing cuts above the packer, 218 joints and several geophones were retrieved
• 246 feet of flatpack was retrieved, some showing swelling
• **After 16 days** the workover was suspended with the packer, >2,700 ft of tubing, 16 or 17 geophones and most of the flat pack and TEC cable remaining in the hole
• A pull plug and abandonment operation was implemented which included a total of 8 cement plugs
• Crosswell seismic acquisition eliminated; short array VSP substituted
Recovered geophone

MBM Lines and flatpack wadded up on a rope spear
2016 Monitoring Results
Shallow Monitoring

- Soil CO$_2$ flux continues to show seasonal variability.
- PFT monitoring at injection wellsite and surrounding oilfield well sites continue to result in non-detects.
- Quarterly groundwater monitoring results indicate non-endangerment of USDWs (*stay tuned for Mike’s presentation*)
Deep Monitoring

- Late 2015 cased hole saturation logs (PNC) identified CO₂ breakthrough at the D-9-8#2 well
- 2016 PNC log of the D-9-9#2 shows no evidence of CO₂ breakthrough
2017 Repeat VSP

• In January 2017 a post-injection VSP was acquired with geophones deployed in the D-9-7#2 injection well.
• Due to the requirement for full pressure control in a perforated well, only a two level string could be run (50 ft spacing). The pre-injection survey utilized an 80-level string (25 ft spacing)
• The short array was moved up and down the well to maximize the acquisition aperture

2012 80-level VSP coverage of reservoir illumination (left) versus 2017 post-injection 2-level repeat (right)
Project Closure Plans

• Complete post-injection monitoring
  - VSP time-lapse processing
  - Continue quarterly groundwater sampling
• Demonstration of CO$_2$ containment within the injection zone and non-endangerment of USDWs using modeling and monitoring results
  - Close out UIC permit
• Temporary or permanent abandonment of remaining project wells and transfer of test site to oilfield operator