



October 31, 2019

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
State Capitol, 10th Floor
600 East Boulevard Avenue
Bismarck, ND 58505-0310

Dear Ms. Fine:

Subject: Quarterly Progress Report Entitled “Integrated Carbon Capture and Storage for North Dakota Ethanol Production – Phase III”; Contract No. R-038-047; EERC Fund 23627

Attached is the subject report for the period of July 1, 2019, through September 30, 2019, that shows the progress that has been made with partners of this project.

Thank you for funding this work. If you have any questions, please contact me by phone at (701) 777-5013 or by e-mail at kleroux@undeerc.org.

Sincerely,

A handwritten signature in black ink, appearing to read "Kerryanne M. Leroux", is written over a faint, larger version of the same signature.

Kerryanne M. Leroux
Principal Engineer, Subsurface R&D

KML/kal

Attachment

c/att: Andrea Holl Pfennig, NDIC



INTEGRATED CARBON CAPTURE AND STORAGE FOR NORTH DAKOTA ETHANOL PRODUCTION – PHASE III

Quarterly Progress Report

(for the period of July 1, 2019, through September 30, 2019)

Prepared for:

Karlene Fine

North Dakota Industrial Commission
State Capitol, 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

Project Period: December 1, 2018 – May 31, 2020
Contract No. R-038-047

Prepared by:

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October 2019

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INTEGRATED CARBON CAPTURE AND STORAGE FOR NORTH DAKOTA ETHANOL PRODUCTION

ACCOMPLISHMENTS

Summary

The Energy & Environmental Research Center (EERC), in partnership with the North Dakota Industrial Commission (NDIC); North Dakota ethanol producer, Red Trail Energy (RTE); and the U.S. Department of Energy (DOE), is conducting the third phase (Phase III) of a multiphase research and development effort to create the first integrated carbon capture and storage (CCS) system in North Dakota for the reduction of carbon emissions from ethanol production and capitalize on evolving low-carbon fuel (LCF) markets. The ultimate goal of this effort is implementation of a small-scale (<200,000 metric tons, or tonnes, CO₂ per year) commercial CCS system at an industrial fuel production facility to generate a reduced-carbon ethanol fuel applicable for LCF programs. Actions this quarter toward supporting continuation of the CCS effort at the RTE site include the following:

- Conducted several meetings to discuss project status and path forward, such as the RTE visit to the EERC on July 9 to present seismic results; the RTE, RPMG, and EERC visit to the California Air Resources Board (ARB) on July 16 to discuss the CCS Protocol; and the RTE–EERC visit to the North Dakota Department of Mineral Resources (DMR) to discuss the provisional design and permitting plan for RTE Well #1.
- Received vendor bids for the potential liquefied CO₂ system, and answered requests for clarification; Trimeric is coordinating a visit/tour of a similar capture system.
- Completed RTE Sampling Event 2, conducted in the project study area August 11–14, 2019; remaining analyses will be completed, and RTE Sampling Event 3 will be conducted next quarter.
- Completed data processing and interpretation from the seismic acquisition survey conducted in March 2019 at the RTE site as well as integration with modeling simulation efforts from Phase I.
- Developed recommendations for the location of RTE Well #1 based on technical and logistical criteria; RTE has chosen a location for drilling this first well.
- Conducted several discussions with the North Dakota CCS Manager and the California CCS Protocol Geologist to research well designs for compliance with underground injection control (UIC) Class VI permit and CCS Protocol requirements, respectively.
- Generated materials for individual landowner results from RTE Sampling Event 1, generalized landowner results from the seismic survey (Geophysical Survey Results

FAQs sheet), and content (e.g., talking points, press release) for the October 2019 Stark County and Richardton City Commission Meetings.

- Created and presented a poster at the DOE National Energy Technology Laboratory (NETL) 2019 Carbon Capture, Utilization, Storage, and Oil and Gas Technologies Integrated Review Meeting, August 26–30, 2019, highlighting Phase III accomplishments to date.
- Next quarter, the CO₂ Capture PDP (process design package) will be completed, and communication will continue with North Dakota DMR and California ARB to continue development of compliant CCS engineering designs, data collection programs, and permit documents toward CCS implementation.

Major Goals of the Project

The ultimate goal of this effort is implementation of a small-scale (<200,000 tonnes CO₂ per year) commercial CCS system at an industrial fuel production facility to generate a reduced-carbon ethanol fuel applicable for LCF programs. To achieve that goal, the EERC, in partnership with NDIC, RTE, and DOE, is conducting the third phase (Phase III) of a multiphase research and development effort to create the first integrated CCS system in North Dakota for the reduction of carbon emissions from ethanol production and capitalize on evolving LCF markets.

Accomplishments under These Goals (for the reporting period)

Specific research objectives for this subtask are to 1) generate site-specific CO₂ capture process designs to obtain engineering design bids, 2) collect of baseline monitoring and site characterization data to determine potential future well locations, 3) create draft CCS North Dakota permitting documents, 4) maintain up-to-date understanding of requirements from evolving CO₂ markets/incentives, and 5) execute of county- and community-level outreach to support stakeholder and community acceptance of implementing an integrated CCS effort.

In summary, Phase III will generate CO₂ capture process designs, conduct baseline monitoring and reservoir characterization, conduct outreach activities, draft permits related to the North Dakota Class VI program, and continue assessment of evolving CO₂ markets. This will facilitate the collection of the data necessary to advance the RTE case study to the next phase of development toward CCS implementation.

Task 1.0 – Develop CO₂ Capture Process Design Package (PDP)

A PDP will be prepared for a potential CO₂ capture facility integrated with industrial fuel production at the RTE site. Project partner, Trimeric Corporation (Trimeric), will generate the PDP, which includes process flow diagrams, heat and material balances, and piping and instrumentation diagrams. Trimeric will then use these data to develop facility costs and vendor recommendations.

Significant accomplishments for Task 1.0 during the reporting period include the following:

- Received all bids for the potential CO₂ liquefaction system, and answered requests for clarification; bids were sent to RTE for review and a vendor was selected.
- Trimeric is coordinating a visit/tour of a CO₂ liquefaction system similar to the RTE facility specifications.
- Trimeric provided a rough draft of the CO₂ Capture PDP to the EERC for review and comment.

Task 2.0 – Initiate Monitoring and Characterization Plans

Defining the natural variability of near-surface environments will assist in generating formal monitoring plans. Improving structural characterization will aid in determining potential well locations. These proposed activities reduce geologic uncertainty of the storage complex for the preparation of a compliant CCS permit package.

Significant accomplishments for Task 2.0 during the reporting period include the following.

Subtask 2.1 – Near-Surface Monitoring

- Evaluated sampling analysis results from RTE Sampling Event 1, and reported to landowners.
- Completed RTE Sampling Event 2, August 11–14, 2019:
 - Completed preparations and logistics for sample collection and team travel.
 - Collected ten soil gas samples for field meter readings, gas chromatography (GC), and isotope analyses; subsequent GC analyses have been completed for all samples collected.
 - Collected three groundwater samples for field parameter readings, and submitted to respective laboratories for water chemistry and isotope analyses (Figure 1); expecting results from EERC and Isotech laboratories by mid-October.

Subtask 2.2 – Reservoir Characterization

- Completed data processing and interpretation from the seismic acquisition survey conducted in March 2019 at the RTE site.



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Figure 1. EERC personnel collecting a water sample field reading in August 2019.

- Completed integration of seismic results into the modeling simulation efforts from Phase I, creating multiple permeability distributions and studying reflections from the seismic results to better understand site-specific heterogeneity in the Broom Creek to inform well placement.
- Completed a combined Inyan Kara and Broom Creek model, incorporating results from seismic survey.
- Completed maps of seismic results, potential well locations, and estimated CO₂ plume stabilization and amalgamated areas from simulation results that are being evaluated by project stakeholders; results were discussed during the July 9 project update meeting to inform potential well placement and the characterization program.

Task 3.0 – Prepare CCS Permit Application Package

Draft documentation will be prepared to satisfy a storage facility permit and a permit to drill (a stratigraphic test hole) compliant with North Dakota regulations. The storage facility

permit covers multiple design aspects such as technical evaluation, area-of-review delineation, a corrective action plan, an emergency and remedial response plan, a casing and cementing program, a testing and monitoring plan, a well-plugging plan, and a postinjection site care and facility closure plan. Pertinent storage facility permit sections will be addressed using data available. The permit to drill a stratigraphic test hole will be prepared with project data such that drilling can commence at the onset of potential Phase IV.

Significant accomplishments for Task 3.0 during the reporting period include the following:

- Progress toward a permit to drill (a stratigraphic test hole):
 - Worked with RTE to develop recommendations for Well #1 location based on technical and logistic criteria; RTE has chosen a location for drilling this first well.
 - Discussed the permit process and UIC Class VI transition pathway with North Dakota DMR Permit Manager Todd Holweger.
 - Generated permit requirements/list of items to be finalized for application submittal (e.g., forms, documents, surveys, etc.); developed drilling roles/responsibilities with RTE.
 - Reviewed papers/journals for CO₂ well casing designs: majority are CO₂ enhanced oil recovery (EOR) wells, with various material options such as internal plastic-coated (IPC), glass-reinforced epoxy (GRE) lining, 9Cr, 13Cr, and 13Cr-4Ni-0.5Mo.
 - Updated the final draft well schematic to include core intervals and completion options for Broom Creek versus Inyan Kara injection; sent to RTE for approval.
 - Completed a landownership plat map, modified the nine-point drilling plan following team review (e.g., calculation procedures for the cementing program), and developed draft logging and coring programs to discuss with North Dakota DMR and California ARB.
- Progress toward draft documents for a North Dakota CO₂ storage facility permit (CO₂ injection):
 - Prepared a summary of regulatory activities/roles relating to acquiring potential Class VI permit(s) through the North Dakota program.
 - Conducted several discussions with DMR CCS Manager Stephen Fried.
 - Compiled a time line for permit review/approval, notifications requirements (applicant and DMR), and the public hearing and comment period.
 - Developed a draft well schematic compliant with Class VI requirements.

- Developed a draft logging/coring program to meet CO₂ storage facility permit requirements.

Task 4.0 – Evaluate Economic Viability

The status of LCF programs and other evolving incentives will be assessed. A cost–benefit analysis will be performed to determine the impact of CCS-related incentives and/or LCF programs with CCS integration. Requirements from LCF/incentive programs and how they can potentially be incorporated into CCS permits will be evaluated to inform how project state regulators might enable participation in out-of-state programs.

Significant accomplishments for Task 4.0 during the reporting period include the following:

- The EERC conducted a webinar with California ARB CCS Protocol Geologist Meredith Petri on August 16, 2019, to discuss well design (following the North Dakota DMR discussions), which was deemed compliant with the CCS Protocol.
- Other LCF program developments: Oregon released draft third-party verification rules on September 11, 2019, following California’s implementation this year; Colorado released a Request for Proposals (also on September 11) to investigate potential for a Midwest LCF program.

Task 5.0 – Execute Public Outreach Plan

Public outreach will provide informational and educational materials related to the proposed characterization and monitoring activities as well as support local public acceptance of a potential CCS effort at the RTE site. Specific stakeholder groups will be targeted for engagement such as landowners and residents, local and regional officials, and educators.

Significant accomplishments for Task 5.0 during the reporting period include the following:

- Completed landowner packets, providing individual results from RTE Sampling Event 1, and updated the Sampling FAQs sheet.
- Completed additional landowner packets, providing generalized results from the seismic survey conducted in March and the updated Geophysical Survey FAQs sheet.
- Prepared content for the California ARB meeting, and updated a North Dakota carbon capture utilization and storage fact sheet to send California ARB electronic copies.
- Created a poster for the DOE NETL annual review meeting, highlighting project accomplishments to date.

- Completed preparations for October 2019 Stark County and Richardton City Commission Meetings:
 - Contacted commissions’ auditors requesting placement on the meeting agenda for RTE presentation of project status.
 - Prepared content including the updated Sampling FAQs, the Geophysical Survey Results FAQs, a press release for any press attending the meeting, and talking points for RTE.

Task 6.0 – Management and Reporting

This task includes managing project activities and ensuring coordination and planning of the project with participants and sponsors.

Significant accomplishments for Task 6.0 management during the reporting period include the following:

- Conducted a project update meeting on July 9, 2019, at the EERC with Dustin Willett, RTE COO; review focused on initial seismic interpretation and updated numerical simulation results as well as upcoming activities such as meeting with North Dakota DMR and California ARB (detailed below).
- Traveled to Sacramento, California, on July 16, 2019, to discuss project status with California ARB, led by RTE (including RPMG); received continued support for the RTE CCS effort and contact information for CCS Protocol questions.
- Traveled to Bismarck, North Dakota, on July 31, 2019, to discuss project status with North Dakota DMR; discussed provisional design and permitting plan for RTE Well #1 to assess compliance with UIC Class VI permit requirements

Plan for the Next Reporting Period to Accomplish the Goals

All activities will continue progressing toward project goals. The CO₂ Capture PDP will be completed. Results from RTE Sampling Event 2 will be compiled and disseminated to landowners; RTE Sampling Event 3 will be conducted. Communication will continue with North Dakota DMR and California ARB to develop compliant draft CCS engineering designs, data collection programs, and permit documents toward CCS implementation. Public outreach materials will be updated, and preparations will begin for a follow-up community open house.

PARTNERS AND FINANCIAL INFORMATION

This project is sponsored by the NDIC Renewable Energy Program, RTE, and DOE. Table 1 shows the budget of \$2,650,000 for this project and expenses through the reporting period.

Table 1. Budget and Expenses Through the Reporting Period

Sponsor	Budget	Expenses	Remaining
NDIC Cash	\$500,000	\$298,028	\$201,972
DOE Cash	\$400,000	\$145,883	\$254,117
RTE Cash	\$950,000	\$568,689	\$381,311
RTE In-Kind	\$800,000	\$404,699	\$395,301
Total Project	\$2,650,000	\$1,012,600	\$1,637,400

PRODUCTS

Publications, Conference Papers, and Presentations

A poster was presented at the DOE NETL 2019 Carbon Capture, Utilization, Storage, and Oil and Gas Technologies Integrated Review Meeting, August 26–30, 2019, in Pittsburgh, Pennsylvania.

Web Site(s) or Other Internet Site(s), Technologies or Techniques, Inventions, Patent Applications, and/or Licenses

The project webpage was updated to include an announcement that near-surface sampling was being conducted in the study area for the August event; it was updated again at sampling conclusion to announce the next sampling event currently planned for November 2019. The updated Sampling, updated Geophysical Survey, and Geophysical Survey Results and FAQs sheets were also uploaded: www.undeerc.org/RedTrailEnergy.

CHANGES/PROBLEMS

None.