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January 30, 2020

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 October 1, 2019, through December 31, 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,

for

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 October 1, 2019, through December 31, 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:

Kerryanne M. Leroux

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January 2020

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EXECUTIVE 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, CO_2 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:

- Completed CO_2 Capture Process Design Package (PDP).
- Completed landowner packets, providing individual results from RTE Sampling Event 2; the final sampling event, RTE Sampling Event 3, was conducted in the project study area in November, with analyses to be completed next quarter.
- A meeting was conducted in November with the North Dakota Department of Mineral Resources (DMR) in Bismarck to discuss the draft RTE permit to drill application and seismic data processing.
- RTE submitted the permit to drill application on November 25, 2019; it was approved by North Dakota DMR on December 2, 2019.
- The second RTE CCS open house was held on December 11 in Richardton, North Dakota, with ~30 community visitors expressing positivity and curiosity regarding the overall RTE CCS effort.
- Next quarter, all technical work will be finalized: the Public Outreach Package and draft final report will be completed, and the CCS Permit Application Package will be near completion.

INTEGRATED CARBON CAPTURE AND STORAGE FOR NORTH DAKOTA ETHANOL PRODUCTION

ACCOMPLISHMENTS

Major Goals of the Project

The ultimate goal of this effort is implementation of a small-scale (<200,000 tonnes CO_2 per year) commercial carbon capture and storage (CCS) system at an industrial fuel production facility to generate a reduced-carbon ethanol fuel applicable for low-carbon fuel (LCF) programs. To achieve that goal, 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 in 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 to capitalize on evolving LCF markets.

Accomplishments under These Goals (for the reporting period)

Specific research objectives for this project are 1) generation of site-specific CO_2 capture process designs to obtain engineering design bids, 2) collection of baseline monitoring and site characterization data to determine potential future well locations, 3) creation of draft CCS North Dakota permitting documents, 4) maintaining up-to-date understanding of requirements from evolving CO_2 markets/incentives, and 5) execution of county- and community-level outreach to support stakeholder and community acceptance of implementing an integrated CCS effort.

In summary, Phase III will generate CO_2 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 CO_2 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 CO_2 Capture Process Design Package (PDP)

A PDP will be prepared for a potential CO_2 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:

- Completed the CO_2 capture PDP.

- Completed all technical work for Task 1.0, and a report detailing results was submitted to NDIC on November 29, 2019.

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

- Completed all analyses from RTE Sampling Event 2; results have been evaluated and reported to landowners.

- Completed RTE Sampling Event 3 on November 19, 2019:

  - Completed preparations and logistics for sample collection and team travel.

  - Collected eight gas samples for field 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; expecting results from EERC and Isotech laboratories by mid-January.

Subtask 2.2 – Reservoir Characterization

- Generated a draft executive summary for the final report on seismic results.

- Presented seismic data processing during the November visit to Bismarck, as requested by DMR.

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 (AOR) 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:

- Completed the permit to drill (a stratigraphic test hole) application:
  - The EERC prepared required documents such as geologic prognosis, drilling prognosis, nine-point drilling plan, wellbore schematic, logging program, and coring program.
  - RTE submitted the permit to drill application on November 25, 2019; it was approved by North Dakota DMR on December 2, 2019.
  - A Richardton special use permit was also required, as the proposed RTE drilling location is located in the Richardton City annex boundary; it was submitted by RTE on November 21, 2019.
- Made progress toward draft documents for a North Dakota CO_2 storage facility permit (CO_2 injection):
  - Maps – Finalizing maps that are not required to include the estimated AOR; created a map layers list for surface structures.
  - Completed first drafts for the pore space amalgamation, geologic exhibits, AOR exhibits, required plans (e.g., emergency response), and well operations; reviewing drafts, creating a uniform structure, and prepping for internal review.
  - Geologic exhibits – Created structural and isopach maps for multiple formations as well as cross sections and a fence diagram of the modeled area; compiled images and began generating required write-ups for 1) description of the depositional environment for Broom Creek Formation; 2) description of the mineralogy of the three lithofacies that comprise the Broom Creek Formation; 3) description of the Opeche Formation (lithology, mineralogy, porosity, permeability); and 4) description of Amsden Formation (lithology, mineralogy, porosity, permeability).
  - AOR delineation – Completed calculations/results, assuming the Broom Creek Formation is overpressured at the RTE site; reviewed the legacy wells to evaluate their cement plugs for development of the monitoring plan.
  - Required plans and well/reservoir information – Developed major plans/sections such as the emergency and remedial response plan, demonstration of financial responsibility, etc., working with RTE on the worker safety plan.
- Completed draft detailed outline for the CCS Permit Application Package.

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:

- Identified requirement for downhole seismicity monitoring in California Air Resources Board (CARB) low-carbon fuel standard (LCFS) CCS protocol and concluded that it could be met by the current fiber optic planned; the EERC has a conference call scheduled with CARB in January 2020 to verify.

- Reviewed the status of Internal Revenue Service (IRS) Section 45Q tax credit. On November 19, 2019, U.S. Representative Terri Sewell (AL-07) introduced the Carbon Capture and Sequestration Extension Act (H.R. 5156) to extend the credit for 1 year, until January 1, 2025; release of IRS guidelines is still pending.

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 2 in November.

- Completed preparations for Stark County and Richardton City Commission Meetings:

  - Contacted commission auditors requesting placement on the meeting agenda for RTE presentation of project status for November and December.

  - Prepared content including a new drilling activity FAQ fact sheet, a press release for any press attending the meeting, and talking points for RTE.

- Completed preparations for RTE Open House 2:

  - Created an invitation for distribution: designed invitation and media advertisement for publication in local/regional newspapers (i.e., Richardton Merchant, Hebron

Herald, and Dickinson Press) as well as on EERC/RTE websites; sent RTE a formal invitation for e-mail and local dissemination; the EERC sent an invitation to city commissioners and North Dakota DMR.

- Completed materials, including five posters (RTE CCS overview, RTE CCS time line, drilling a test hole, permitting poster, geophysical survey and environmental sampling), a large vertical banner (updating the stratigraphic column and potential monitoring techniques), and a visual display (several rock permeability types).

- The event (Figure 1) was held on December 11 in Richardton, North Dakota, with ~30 community visitors, including participation by the EERC and RTE; community visitors expressed positivity and curiosity regarding the overall RTE CCS effort.

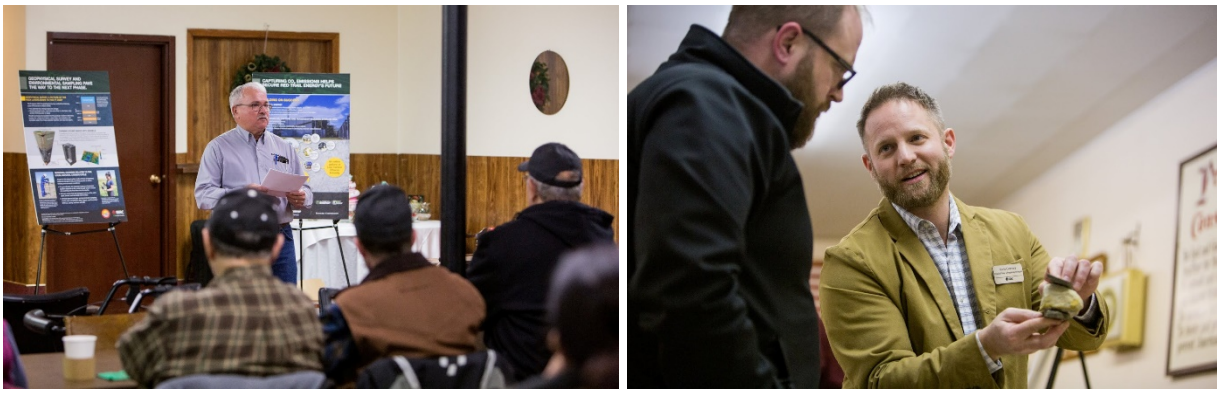

Figure 1. RTE (left) and EERC (right) personnel discussing the project with Richardton community members at the open house held in December 2019.

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 during the reporting period include the following:

- Sent RTE updated press materials for the November 12, 2019, Richardton City Commission Meeting.

- On November 22, traveled to Bismarck, North Dakota, to discuss RTE's draft permit to drill application (see Task 3.0) and seismic data processing (see Task 2.0) to North Dakota DMR.

Plan for the Next Reporting Period to Accomplish the Goals

All activities will continue progressing toward project goals. Technical work will be finalized. The Public Outreach Package and draft final report will be completed. The CCS Permit Application Package will be near completion.

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	$467,051	$32,949
DOE Cash	$400,000	$239,000	$161,000
RTE Cash	$950,000	$731,902	$218,098
RTE In-Kind	$800,000	$761,610	$38,390
Total Project	**$2,650,000**	**$2,199,563**	**$450,437**

PRODUCTS

Publications, Conference Papers, and Presentations

- A new fact sheet and media alerts were prepared to support RTE's presentation at fall 2019 Stark County and Richardton City Commission meetings, providing information on the seismic survey, sampling events, and upcoming drilling effort (detailed earlier).

- Several posters (detailed earlier) were generated to present at the December RTE open house in Richardton.

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

- Updated the project Web page to include the open house announcement (temporary) and current project fact sheets: www.undeerc.org/RedTrailEnergy.

- Advertisements to notify residents of the open house were also displayed on the RTE and area city Facebook pages (detailed above).

CHANGES/PROBLEMS

None.