April 30, 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:


Attached is the subject report for the period of January 1, 2019, through March 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,

[Signature]

Kerryanne M. Leroux  
Principal Engineer, Subsurface R&D

KML/kal

Attachment

c/att: Andrea Pfennig, NDIC
INTEGRATED CARBON CAPTURE AND STORAGE FOR NORTH DAKOTA ETHANOL PRODUCTION – PHASE III

Quarterly Progress Report

(for the period of January 1, 2019, through March 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. R038-047

Prepared by:

Kerryanne M. Leroux

Energy & Environmental Research Center
University of North Dakota
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Grand Forks, ND 58202-9018

April 2019
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INTEGRATED CARBON CAPTURE AND STORAGE
FOR NORTH DAKOTA ETHANOL PRODUCTION – PHASE III

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 low-carbon fuel (LCF) programs. Actions this quarter toward supporting continuation of the CCS effort at the RTE site include the following:

- Trimeric completed the updated design basis document for a CO₂ liquefaction facility specific to the RTE site; draft process flow design and heat/material balance documents were also completed.

- The draft near-surface sampling plan was completed, including potential groundwater wells and soil gas sampling locations; a draft environmental health & safety plan was completed; and field instrumentation is being prepared for the first sampling event to commence next quarter.

- The North Dakota permit manager approved the RTE geophysical exploration permit February 26, and the RTE seismic survey was successfully completed by March 28.

- A plan for geomechanical data acquisition and evaluation for a future stratigraphic test well was completed (necessary for CO₂ storage permitting); all reported dwellings/wells within the project area were completed, and site reconnaissance is under way to identify any other structures in the area.

- The final version of California’s CCS Protocol document approved in January 2019 was reviewed, and we discussed potential schedule(s) for contacting California and Oregon LCF program teams regarding current status on CCS incorporation efforts and path(s) forward.

- The EERC generated several project fact sheets and notifications to assist RTE with outreach and permit compliance relating to the seismic survey conducted in March 2019; a project open house was held in Richardton, North Dakota, with ~30 community visitors and generally positive feedback for the project.
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, North Dakota ethanol producer 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 1) generation of site-specific CO₂ 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 CO₂ 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 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 included the following:

- Completed and received RTE approval for updated design basis document generated by Trimeric for a CO₂ liquefaction facility specific to the RTE site.
- Trimeric completed the simulation work for primary CO₂ processing and the secondary ammonia refrigeration system.
- Preliminary sizing of the desiccant dryers and ammonia refrigeration compressor was also conducted, as well as estimating horsepower requirements for the CO₂ compressor.
• Trimeric completed draft process flow design and heat/material balance documents, which were sent to the EERC for review.

**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 included the following.

**Subtask 2.1 – Near-Surface Monitoring**

- Completed an in-depth investigation of groundwater wells within the project study area, (e.g., drilling depths, casings, etc.) as identified from the North Dakota State Water Commission (SWC); assessed additional wells identified during the seismic survey reconnaissance effort.

- Investigated soil gas sampling locations, including water and land information obtained during the seismic survey reconnaissance effort, as well as additional information obtained regarding baseline monitoring requirements for a potential Class VI permit in North Dakota (e.g., potential amalgamated area focus).

- Determined the specific groundwater wells and soil gas sampling locations to be included in near-surface sampling activities.

- Completed a draft near-surface sampling plan and environmental health & safety plan in preparation for execution of sampling activities next quarter.

- Sent field instrumentation for groundwater and soil gas sampling to respective vendors for required maintenance/calibration in preparation for first sampling event.

**Subtask 2.2 – Reservoir Characterization**

- Completed a draft seismic design, which was sent to RTE’s general contractor for formal design generation.

- Provided technical and administrative support to RTE for execution of the seismic survey, such as information on contracting options and the North Dakota permit process, generating landowner notification templates, mapping, and shapefiles, etc.

- Assisted the seismic acquisition company with the North Dakota permitting process, facilitating communication with the state permitting agent and seismic inspector.
• North Dakota permit manager approved the RTE geophysical exploration permit February 26.

• Provided on-site technical advisement to RTE during the reconnaissance and data acquisition activities to overcome challenging terrain and weather issues.

• Received and reviewed final data acquisition plots to ensure no impact to coverage in the reservoir because of limited-access areas, as well as sources moved because of topography and offset requirements.

• Successfully completed RTE seismic survey, with all receivers collected from the project area by March 28 (Figure 1).

Figure 1. Vibroseis trucks from the RTE seismic survey (top) and seismic data loggers with the RTE facility in the background (bottom).
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 included the following:

- RTE/EERC met with Richardton mayor and City Zoning to discuss special use permit requirements for potential future drilling activities.

- Received and reviewed North Dakota Class VI (storage facility permit) application Guidelines and Checklist documents from North Dakota Department of Mineral Resources (DMR), the Class VI permitting authority in North Dakota.

- Identified all reported groundwater wells within the project area as available from the SWC database; site reconnaissance is under way to identify other potential dwellings/wells in the area.

- Identified one private well in the current projected area as penetrating the Fox Hills (lowest USDW [underground source of drinking water]); one nearby municipal well (outside of projected area) also reaches the Fox Hills aquifer.

- Completed collection of groundwater well data from driller’s log files; began verifying well data via comparison to state reports and other literature.

- Began evaluation of offset oil and gas wells for well bore integrity; updated preliminary designs of the injection and monitoring wells (from Phase I).

- Began review for hydrogeological and aquifer evaluations such as hydraulic communication (flow paths within aquifers) in the project area.

- Outlined approach for drafting North Dakota Class VI permit documents, such as a) drilling and completion plans for monitoring/injection wells, b) corrosion monitoring and prevention plan, c) wellbore integrity evaluation of all wells within the project area (including remediation plan if needed), and d) wellbore monitoring plan (e.g., proposed mechanical testing frequency) for planned wells and existing wells as determined by the integrity evaluation.
• Completed a plan for collecting and evaluating geomechanical data from a stratigraphic test well (which will provide data necessary to complete a potential ND Class VI permit).

**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 included the following:

• Reviewed final version of California’s CCS Protocol document approved in January 2019 to identify any additional changes since last version was publicized; changes noted were all nontechnical.

• Participated in several discussions with RTE and Renewable Products Marketing Group (i.e., RTE’s contracted marketing group) to schedule potential conference call(s) and/or travel to contact California and Oregon LCF program teams for current status on CCS incorporation efforts and discussion of path(s) forward.

**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 included the following:

• Generated landowner notification letter templates for RTE to finalize and distribute to landowners directly affected by the survey and within a ½-mile buffer, as required by the North Dakota seismic survey permit.

• In compliance for the seismic permit, generated and submitted a public notice of the survey to local/regional newspapers (i.e., Richardton Merchant, Hebron Herald, and Dickinson Press).

• RTE and EERC traveled to Dickinson and Richardton, North Dakota, respectively, to present at the Stark County Commission (February 5) and Richardton City Commission (February 13) meetings, providing information on the planned seismic survey.
• Completed creation of several formal fact sheets for the Commission presentations and landowner notification packets: 1) RTE CCS fact sheet, 2) seismic survey FAQ sheet, and 3) 1-page seismic survey map (general and individual landowner maps).

• Generated additional information items to include in the formal Commission packets such as an approximate time line for seismic-related activities and a media advisory summarizing the commission appearances, seismic survey, and project in general.

• Created a project open house 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 EERC/RTE Web sites and Facebook posts (e.g., Richardton and Hebron city Facebook pages); developed form letters for individual invites (e.g., landowners, city/county/state officials, science teachers, etc.).

• Completed materials for the open house, including six posters (welcome sign, RTE CCS overview, RTE CCS time line, general CCS information, RTE seismic survey map, and project scope), a large vertical banner (displaying a stratigraphic column and potential monitoring techniques), and two visual displays (varying seismic equipment and several rock permeability types).

• An open house (Figure 2) was held on March 6 in Richardton, North Dakota, with ~30 community visitors, including participation by EERC, RTE, and DMR; feedback was generally positive and supportive for the project.

• Completed a sampling FAQ sheet and updated seismic FAQ sheet to reflect survey completion for landowner discussions and Stark County and Richardton City Commission meetings occurring in early April 2019, to provide an update on the completed seismic survey and information on the planned near-surface sampling.

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:

• Held internal and partner (RTE, Trimeric) kickoff meetings to generate and discuss detailed action plans for project execution.

• Completed project time line by task, and shared interactive calendar with client.

Plan for the Next Reporting Period to Accomplish the Goals

All activities will continue progressing toward project goals: predesigns for the potential CO₂ capture system at the RTE site will be completed such that a bid package can be generated
Figure 2. EERC personnel discussing the project with Richardton community members at the open house held in March 2019.

for obtaining vendor quotes of major equipment. The first near-surface sampling event will be conducted, with collected groundwater and soil gas samples submitted for laboratory analyses.

Processing will be completed of the seismic data collected, and technical interpretation and evaluation of the results will begin. Drafts of North Dakota Class VI permit-required maps and several plans (e.g., emergency and remedial response plan, corrosion monitoring and prevention plan, etc.) are expected to be completed or near completion. The EERC and RTE will continue monitoring and communicating with California and Oregon LCF programs on progress toward developing pathways and/or related documentation. Public outreach materials will be updated as necessary, and plans will begin for a potential follow-up community open house in the third quarter of 2019.

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

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* In-kind reports submitted for the reporting period are currently being processed and will be included in the next report.

PRODUCTS

Publications, Conference Papers, and Presentations

- Several factsheets and media alerts were prepared to support RTE’s presentation at February and April 2019 Stark County and Richardton City Commission meetings providing information on the seismic survey and sampling events (detailed above).

- Notices were published in local/area newspapers to notify residents of the seismic survey, as required by North Dakota permit (detailed above).

- Several posters (detailed above) were generated to present at the RTE open house in Richardton on March 6, as well as at the RTE annual meeting in Bismarck on March 29.

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 generated project factsheets: 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).

- An EERC blog article was written to showcase the open house: https://undeerc.blogspot.com/2019/04/red-trail-energy-hosts-open-house-event.html.

CHANGES/PROBLEMS

None.