Energy & Environmental Research Center
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April 14, 2023

Mr. Reice Haase
Deputy Executive Director
ATTN: Lignite Research Program
North Dakota Industrial Commission
600 East Boulevard Avenue
State Capitol, 14th Floor
Bismarck, ND 58505-0840

Dear Mr. Haase:

Subject: EERC Proposal No. 2023-0147 Entitled "Coal Creek Carbon Capture: Geologic CO_2 Storage Complex Development"

Attached for your consideration is a proposal to advance development of a geologic carbon dioxide (CO_2) storage complex in central North Dakota to store CO_2 captured from the Coal Creek Station power plant. A portion of the requested funds would be used as cost share for a proposal submitted to the U.S. Department of Energy (DOE) Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Initiative in November 2022 to characterize and permit the proposed geologic CO_2 storage complex. This portion of the requested funding would be contingent on the project being selected for funding by DOE. DOE has indicated selection of CarbonSAFE awards will occur in Quarter 2 of 2023.

The $100 application fees for this proposal and EERC Proposal No. 2023-0146 are provided through ACH Transaction Number 252483. The Energy & Environmental Research Center (EERC), a research organization within the University of North Dakota, an institution of higher education within the state of North Dakota, is not a taxable entity; therefore, it has no tax liability.

This transmittal letter represents a binding commitment by the EERC to complete the project described in this proposal. If you have any questions, please contact me by telephone at (701) 777-5344 or by e-mail at alivers@undeerc.org.

Sincerely,

DocuSigned by:
Amanda Douglas
Amanda Livers-Douglas
Assistant Director for Integrated Subsurface Projects

Approved by:

DocuSigned by:
Tami Votava
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for
Charles D. Gorecki, CEO
Energy & Environmental Research Center

AJL/rlo

Attachment

Lignite Research, Development and Marketing Program

North Dakota Industrial Commission

Application

Project Title: Coal Creek Carbon Capture: Geologic CO_2 Storage Complex Development

Applicant: University of North Dakota Energy & Environmental Research Center

Principal Investigator: Amanda J. Livers-Douglas

Date of Application: 4/14/2023

Amount of Request: $6,119,690

Total Amount of Proposed Project: $50,387,901

Duration of Project: 39 months

Point of Contact (POC): Amanda J. Livers-Douglas

POC Telephone: (701) 777-5344

POC: Email: alivers@undeerc.org

POC Address: 15 North 23rd Street, Stop 9018

Grand Forks, ND 58202-9018

ABSTRACT

Objective: The objective of this study is to advance development of a geologic carbon dioxide (CO_2) storage complex in central North Dakota to store CO_2 captured from Coal Creek Station power plant. The project will consist of two stages. The objective of Stage 1 is to conduct a set of activities necessary to advance site characterization, including evaluation of existing two-dimensional (2D) seismic data, geologic modeling, and CO_2 injection simulations to inform placement and design of a stratigraphic test well. The objective of Stage 2 is to fully characterize and permit the geologic CO_2 storage complex. The Energy & Environmental Research Center (EERC) submitted a proposal to the U.S. Department of Energy (DOE) Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Initiative in November 2022 for 80% of the funding to support Stage 2 efforts. DOE has indicated selection of CarbonSAFE awards will occur in Quarter 2 of 2023.

Expected Results: Results from Stage 1 will inform a provisional storage facility-permitting area (pore space lease area); the geologic storage prospects to be targeted for additional characterization (e.g., Madison, Interlake, Red River, Deadwood) in Stage 2; and the location, engineering design, drilling program, and data acquisition program for a stratigraphic test well to be drilled as part of Stage 2. Successful completion of Stage 2 will result in a fully characterized storage complex and permitted geologic CO_2 storage complex that is ready to transition to construction and operation.

Duration: 39 months (June 1, 2023 – September 1, 2026)

Total Project Cost: The total value of the currently scoped project is $50,387,901 (Stage 1: $2,700,000 and Stage 2: $47,687,901). This proposal requests a total of $6,119,690 from the North Dakota Industrial Commission Lignite Research, Development, and Marketing Program (LRDMP). Project partner, Rainbow Energy Center (REC), will provide $6,119,691. DOE will provide $38,148,520.

Participants: The project lead is the EERC, and the project will be conducted in partnership with LRDMP, DOE, REC, and Neset Consulting Service, Inc.

PROJECT SUMMARY

The Energy & Environmental Research Center (EERC) and project partners, Rainbow Energy Center (REC) and Neset Consulting Service, Inc. (Neset), propose to characterize and permit a geologic carbon dioxide (CO_2) storage complex in central North Dakota to store up to 200 million metric tons (MMt) of CO_2. Successful completion of the proposed project will result in a fully characterized and permitted storage complex that is ready to transition to construction and operation. The proposed project will advance the development of carbon capture and storage (CCS) at Coal Creek Station power plant (Coal Creek), which will reduce the CO_2 emissions from the plant by 95%, representing a 19% reduction of CO_2 emissions from North Dakota's stationary sources and, in turn, provide Coal Creek with a pathway to low-carbon energy, resulting in resiliency against future legislation, regulations, and/or taxes associated with carbon emissions by providing for safe, reliable, affordable, environmentally prudent baseload energy generation for the United States. Additionally, the development of CCS at Coal Creek will create approximately 35–40 long-term jobs and over 2000 direct/indirect short-term construction jobs. The proposed project will facilitate attracting, training, and retaining a skilled and well-qualified workforce for these new and existing jobs. The proposed project is also designed to provide internship opportunities to students from minority-serving institutions and tribal colleges.

The project will consist of two stages. The objective of Stage 1 is to conduct a set of activities necessary to advance site characterization, including evaluation of existing two-dimensional (2D) seismic data, geologic modeling, and CO_2 injection simulations to inform placement and design of a stratigraphic test well to be drilled in Stage 2. The objective of Stage 2 is to fully characterize and obtain a permit for one or more geologic CO_2 storage facilities sufficient for storing 200 MMt of CO_2. Stage 2 is contingent on the EERC accepting cofunding through the U.S. Department of Energy's (DOE's) Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Initiative to which the EERC submitted an application that is pending decision. As part of Stage 2 efforts, the EERC and project team will prepare and submit

applications for underground injection control (UIC) Class VI storage facility permit(s) sufficient for the Coal Creek development scenario. Near-surface and subsurface data will be acquired and analyzed to fully characterize the proposed storage complex. The EERC will oversee acquisition and processing of three-dimensional (3D) seismic data; drilling, coring, logging, testing, and completion of a stratigraphic test well; and collection of baseline water quality data from underground sources of drinking water (USDWs). Geologic modeling and reservoir simulation will incorporate characterization data to delineate the extent of pore space necessary to store CO_2 and determine the area of review (AOR). In addition, the project will include a pipeline front-end engineering and design (FEED) study and assess National Environmental Policy Act (NEPA)-related issues for the project's capture, transport, and storage site.

PROJECT DESCRIPTION

Objectives

The objective of the proposed effort is to advance development of CCS at Coal Creek by characterizing and obtaining a permit for a storage complex capable of accommodating 200 MMt of CO_2. This would provide Coal Creek with a pathway to low-carbon energy which would provide Coal Creek with resiliency against future legislation, regulations, and/or taxes associated with carbon emissions. Development of CCS at Coal Creek would allow Coal Creek to continue to provide safe, reliable, affordable, and environmentally prudent baseload energy. Successful completion of the proposed project would also position Coal Creek to be eligible to apply for hundreds of millions of dollars through loan programs or funding made available through the Bipartisan Infrastructure Law and Inflation Reduction Act to support construction of capture facilities.

Methodology

Stage 1: The proposed Stage 1 scope of work (SOW) includes activities necessary to plan and design a stratigraphic test well to characterize the prospective geologic CO_2 storage complex; the Broom Creek, Madison, Interlake, Red River, and Deadwood Formations; and associated upper and lower confining

zones. To inform site selection for the stratigraphic test well and support the well design, the geologic storage complex will be evaluated for the ability to geologically store up to 200 MMt of CO_2 to be injected over 20 years. Prior regional characterization work conducted by the EERC will be leveraged to inform site selection through reservoir simulation and location-specific screening. Additionally, the EERC has identified existing 2D seismic data in the project area that are available for licensing. Interpretation of the 2D seismic data will be used to support the stratigraphic test well site selection and design of the 3D seismic survey. Stage 1 is divided into five tasks: Task 1.0 site selection, geologic modeling, and simulations; Task 2.0 stratigraphic well design; Task 3.0 seismic acquisition design and planning; Task 4.0 material recommendation and testing; and Task 5.0 project management.

Detailed descriptions of the proposed tasks are considered confidential. Appendix A contains the confidential information request form associated with the confidential task descriptions which are included in Appendix B. The information in Appendix B is confidential.

Stage 2: The Stage 2 SOW will advance characterization, development, and permitting of a large-scale geologic CO_2 storage complex in central North Dakota to store up to 200 MMt of CO_2. Stage 2 is contingent upon the EERC accepting cofunding associated with a companion proposal submitted to DOE's CarbonSAFE Initiative. As such, the objectives and SOW are designed to align with the format and requirements of the CarbonSAFE Initiative. The objectives of the first 18 months of Stage 2 are to fully characterize the proposed storage complex; prepare and submit a North Dakota storage facility permit application in accordance with the UIC Class VI permitting program administered under North Dakota State primacy; prepare U.S. Environmental Protection Agency (EPA) NEPA documentation; and implement a community benefits plan (CBP) to engage a diverse, inclusive set of community stakeholders and help build the values of diversity, equity, inclusion, and accessibility (DEIA); environmental justice; broad-based community engagement; and worker support more deeply into all project activities. The objectives of the second 18 months of Stage 2 are to compile the necessary

information to inform a final investment decision and prepare the CCS project for transition into construction and operation through completion of a pipeline FEED study, finalization of a storage field development plan, and creation of business and financial plans.

Stage 2 is divided into nine tasks to align with the project format prescribed by the DOE CarbonSAFE Initiative and included in the proposal to DOE. Task 1.0, a project management, planning, and reporting activity, will span the duration of the project and ensure that all subsequent tasks and activities are completed according to specified timelines and provides for both LRDMP and DOE reporting. Task 2.0 covers NEPA compliance and submittal of an environmental information volume (EIV). Task 3.0 will develop permitting documents necessary to construct and operate a commercial geologic storage hub. Permitting documents will be developed specific to North Dakota's UIC Class VI primacy program. Modeling and simulation activities will be conducted as part of Task 3.0 to address UIC Class VI regulations, predict the boundaries of the injected CO_2 plumes at the proposed site, and determine each AOR to support Class VI permits and inform development of monitoring plans. Task 4.0 includes activities required to characterize the CO_2 storage complex of the proposed project, including drilling/coring/testing/logging one new stratigraphic test well, acquisition and analysis of a new 3D seismic survey, and characterization of core and data from the new stratigraphic test well and offset well(s). Task 5.0 will develop a storage field development plan to inform commercialization of the storage hub. Task 6.0 will conduct CO_2 source feasibility studies to demonstrate due diligence and include all necessary information to support development of the Class VI permit applications. These CO_2 source feasibility studies will build on ongoing and existing FEED studies conducted by the EERC and project partners. Task 7.0 will initiate a pipeline FEED study to include pipelines needed to connect CO_2 sources to the storage site. Task 8.0 will direct collaborative efforts with project partners for development of business and financial plans as entry requirements for future CarbonSAFE funding. Task 9.0 includes a societal considerations and impacts assessment and plans that incorporate DEIA;

Justice 40 (J40) Initiative; community, labor, and stakeholder engagement; and quality jobs. Proposed tasks are described in greater detail in Appendix B.

Anticipated Results

Results from Stage 1 will inform a provisional storage facility-permitting area (pore space lease area); the geologic storage prospects to be targeted for additional characterization (e.g., Madison, Interlake, Red River, and Deadwood Formations) in Stage 2; and the location, engineering design, and drilling program for a stratigraphic test well to be drilled as part Stage 2. Stage 1 results will also include a provisional design for a 3D seismic survey to be conducted as part of Stage 2. Successful completion of Stage 2 will result in a fully characterized and permitted geologic CO_2 storage complex that is ready to transition to construction and operation.

Facilities, Resources, Techniques to Be Used, Their Availability and Capability

The EERC has all necessary office, laboratory, and computer resources that are immediately available to complete the proposed SOW. Laboratory resources include the Analytical Research Laboratory, Applied Geology Laboratory, and Natural Materials Analytical Research Laboratory, which are equipped to process, test, and analyze the near-surface (e.g., groundwater, soil gas) and reservoir (e.g., core, fluids) materials needed to characterize the storage facility. Computer resources include industry-standard modeling, simulation, and geophysical analysis software and high-performance workstations capable of running this software. Project partner, Neset, has a state-of-the-art facility, including office space, a full-service shop, total on-site electrical power backup, and a geosteering operations center capable of providing service across the entire Williston Basin and beyond. This capability ensures Neset will be able to provide drilling support services no matter when the wells are ultimately drilled. Project partner, REC, has extensive office and computer resources at its headquarters in Bismarck, North Dakota. The general area anticipated to contain the project field site encompasses a 314-square-mile area in McLean, Mercer, and Oliver Counties near Coal Creek. The majority of the land within this area is owned by REC

and North American Coal Corporation (NACCO), which have each provided the EERC with field site access commitment letters (Appendix C).

The individual partners mentioned within the proposed project represent decades of experience in drilling, geological consulting services, subsurface data collection, CCS project development, and coal plant operations. All project participants have committed the necessary resources to execute this project, as evidenced by the letters of support in Appendix C.

The industry-standard techniques to be used to accomplish the proposed SOW are discussed in the Methodology section and are further described in Appendix B.

Environmental and Economic Impacts while Project Is Underway

Field activities for the proposed project will include baseline soil gas and groundwater sampling, drilling a dedicated groundwater-monitoring well, drilling a stratigraphic test well, and acquisition of a 3D seismic survey and survey of potential flowline routes. All field activities will be conducted in accordance with state and local laws, and field crews will follow industry-standard safety practices. The project team will work with landowners to get permission to access their land for field activities and will work with landowners to minimize any inconveniences. No permanent adverse environmental impacts associated with field activities are anticipated.

Baseline soil gas and groundwater sampling will consist of a crew of one to two people on-site for a week four different times of the year. The crew will utilize handheld equipment to collect samples and a small pickup truck to travel while on-site.

A 400- by 400-ft well pad and access road will be constructed for drilling the stratigraphic test well. This will involve heavy equipment, drill rig, trailers, logging trucks, etc. Pad construction is anticipated to take a month, and drilling activities are anticipated to take 2 months. No area outside this 400- by 400-ft well pad and access road is anticipated to be disturbed. Drilling activities will be carried out under a permit issued by the North Dakota Industrial Commission (NDIC).

A small truck-mounted drill rig will be used to drill the dedicated groundwater-monitoring well. This well will be drilled on the stratigraphic test well pad.

The 3D seismic survey will comprise a network of vibrational sensors and two source trucks (called vibroseis trucks). Small sensors will be inserted 2–3 inches into the ground every ~165 ft along lines that are spaced approximately 330 ft apart to record reflected vibrations generated during the survey. The sensors will be pressed into the ground by hand by field crews walking and driving small pickup trucks or all-terrain vehicles (ATVs). Once installed, the sensors remain in place up to 2 weeks, as the large vibroseis trucks travel through the survey area along lines spaced 660 ft apart, until the survey is finished. At 165-ft intervals along lines, the trucks will stop and vibrate the ground for 1–2 minutes. The trucks will not vibrate the ground within 300 ft of buildings and other infrastructure. A low-level noise similar to that of a large passing truck will be generated at each location from the vibrating truck-mounted vibrating plates. A person standing 100 ft from the source will not feel ground vibration. The project team will acquire a geophysical permit issued by NDIC, contact landowners before the survey work to request permission to drive vehicles and place sensors on their land, and follow all geophysical permit requirements. Care will be taken to avoid or minimize any environmental impacts and maintain normal traffic flow.

Surveying potential flowline routes will be done by a one- to two-person crew utilizing handheld equipment. The crew will use a small pickup truck to travel while on-site.

During the project, it is anticipated that field crews will be lodging, shopping, and eating at local establishments, which will have a positive economic impact on local communities.

Ultimate Technological and Economic Impacts

The lignite-fired power plants in North Dakota present an opportunity to demonstrate the economic feasibility of large-scale CCS for the existing domestic coal fleet, as they are optimally located near both appropriate geologic storage and oil fields amenable to enhanced oil recovery (EOR) operations. The

economic health of the central region of North Dakota is tied to energy jobs in the area. Currently, the lignite industry directly employs 3623 people, with another 9500 indirect employees supported by the industry, accounting for over $5.4 billion in economic impact. Technology advances that continue the responsible use of lignite and bring new industries to the region are critically needed to sustain and grow these jobs. Based on a recent study by the EERC, the economic impact to a state such as North Dakota from development of a new carbon capture and EOR industry would be tremendous if deployed statewide: $2.5 billion to $3.0 billion in annual economic activity, state revenue increased by $160 million per year, and creation of approximately 8000 long-term jobs (Stanislowski et al., 2019). At Coal Creek alone, approximately 35 to 40 direct jobs will be created.

With this project, the project team aims to perform the work necessary to develop large-scale CCS associated with Coal Creek that will reduce environmental impacts and increase sustainability of energy production and delivery. This project will fully characterize the site and obtain the permits for a storage complex for storage of up to 200 MMt of CO_2, which will accommodate CO_2 captured from Coal Creek and will have excess capacity for additional future sources that could provide further economic opportunity, optionality, and resilience for both the facility and the region.

To date, CO_2 storage evaluations and operations have focused exclusively on sandstone formations. Carbonate formations also offer significant CO_2 storage potential in North Dakota but have not yet been sufficiently evaluated to realize their potential. This project will include characterization of several carbonate formations for CO_2 storage. Understanding the storage capacity and technical challenges associated with CO_2 storage in carbonates will provide the critical information needed to support the business case for other CCS projects looking to store CO_2 in a carbonate formations. As the number of commercial CCS projects being developed in North Dakota increases, CO_2 storage in carbonate reservoirs will be absolutely vital for optimizing use of pore space. Future CCS projects in North Dakota will benefit through the key information relating to the storage potential and

characteristics of carbonate formations in the Williston Basin that will be generated through the proposed work.

Why the Project Is Needed

The Polar Vortex (which caused severe limitations to wind power generation capacity and natural gas availability) that swept through the Midwest in early 2019 and the 2021 Electric Reliability Council of Texas (ERCOT) challenges are profound reminders of why we need to keep our entire power generation mix on the table; CCS can serve as a long-term solution to carbon emissions while also providing firm baseload generation to mitigate the impact of intermittent supply from renewables on grid reliability. Ultimately, Coal Creek can serve as a model and example for the rest of the nation's existing coal fleet and provide baseload power with reduced CO_2 emissions.

Investing in this project ensures that this initiative can successfully move down the project development path, and anticipated subsequent projects in North Dakota will be better-informed and more likely to succeed and make progress toward Governor Burgum's goal of North Dakota carbon neutrality by 2030.

STANDARDS OF SUCCESS

The proposed study is to advance development of CCS at Coal Creek. The study will result in a fully characterized and permitted storage complex that is ready to move to construction. Successful outcomes for the project include obtaining a North Dakota UIC Class VI storage facility permit(s) for the storage complex. Additionally, at the end of the project, all required leases, development plans, business plans, and other agreements related to the storage complex will be in place to inform a final investment decision. By the end of the project, Coal Creek will meet the prerequisites to apply for additional funding through the DOE CarbonSAFE project to support construction of pipeline, compressors, injection wells, and other associated infrastructure.

BACKGROUND/QUALIFICATIONS

Background

The project site and surrounding area have a solid foundation of existing data and models, which the project team can immediately take advantage of to support the proposed Stage 1 activities. The EERC has access to a catalogue of geologic materials, data, and interpretations collected through publicly funded research efforts in the region. In addition, the EERC has worked with Midwest AgEnergy (MAG) to characterize, design, and develop a UIC Class VI storage facility permit application for the Brook Creek Formation within the project area to store CO_2 from the Blue Flint Ethanol plant. These efforts resulted in the collection of core samples; well logs; and seismic, petrophysical, geomechanical, and geochemical data sets from several of the prospective storage formations that are applicable to the proposed effort. The data collected by MAG for a subset of the prospective storage formations are specific to the area of interest being investigated and are available to the project through existing agreements between REC and MAG.

MAG worked with the EERC to conduct feasibility studies in the project area in 2019 that included the construction of geologic models and the numerical simulation of CO_2 injection to estimate the viability of subsurface CO_2 storage within the area surrounding Blue Flint Ethanol, including nearby Coal Creek. The main input data for the geologic models, including geophysical well logs and formation top depths from legacy wells, were obtained from NDIC's publicly available online database. In 2020, MAG worked with the EERC and the LRDMP to drill, core, and log a stratigraphic test well, MAG 1, and conducted a 3D seismic survey to begin collecting site-specific data to characterize the subsurface for CO_2 storage to support permitting of a UIC Class VI storage facility capable of storing CO_2 associated with the Blue Flint Ethanol plant. Data were compiled from characterization and modeling efforts to prepare and submit a UIC Class VI permit application to NDIC, which demonstrates that the Broom Creek Formation is capable of safely storing approximately 200,000 Mt of CO_2 per year. Simulation scenarios

run as part of this effort demonstrated a potential for upwards of 1 MMt of CO_2 per year to be injected annually into the Broom Creek Formation in a single injection site without exceeding the regulatorily defined maximum bottomhole pressure constraint of 90% of the formation fracture pressure gradient.

Also, geologic characterization that was previously completed as part of a separate CarbonSAFE Phase II North Dakota Integrated Carbon Storage Complex Feasibility Study funded by DOE associated with Project Tundra showed the potential of permanently and safely storing at least 50 MMt of CO_2 within 30 years within a CO_2 storage complex located approximately 20 miles to the southwest of Coal Creek. The results of that project show that two of the prospective formations within the storage complex, the Broom Creek and Black Island–Deadwood Formations, are capable of storing large amounts of CO_2. Data sets generated from that project include the drilling, coring, logging, testing, sampling, and characterization of a stratigraphic test well (BNI 1) and interpretation of an existing 9-mi^2 3D seismic survey.

Additionally, efforts associated with Project Tundra eventually led to a CarbonSAFE Phase III award. As part of the ongoing CarbonSAFE Phase III efforts associated with Project Tundra, geologic characterization data were collected from drilling, coring, logging, testing, and sampling of two recent stratigraphic test wells approximately 20 miles to the southwest of Coal Creek (J-LOC 1 and Liberty 1). An injection test was also conducted at this site along with the acquisition of a 12-mi^2 3D seismic survey.

The characterization data collected from Project Tundra complement the information available from MAG. These data sets confirm the regional potential of the Broom Creek and Black Island–Deadwood to store well over 200 MMt. However, although characterization and modeling studies conducted by MAG are sufficient to permit the Broom Creek storage complex to meet MAG's 200,000 Mt/year target injection volumes, local geology within the Broom Creek needs to be further assessed relative to the much larger injection rates associated with the Coal Creek CCS scenario. Furthermore, geologic uncertainties still exist within deeper storage prospects such as the Madison,

Interlake, Red River, and Black Island–Deadwood Formations, which will likely be required, in addition to the Broom Creek Formation, to achieve the 200 MMt storage target associated with Coal Creek's development scenario. Collection and analysis of additional data as part of the proposed Stage 2 scope of work will reduce uncertainties present in each of the prospective storage formations and will provide the data necessary to design, optimize, and permit a storage complex to meet the target injection volumes of the proposed Coal Creek development scenario.

Qualifications

The EERC will lead the project, with support from project partners, REC and Neset. The principal investigator (PI) is Ms. Amanda Livers-Douglas, EERC Assistant Director for Integrated Subsurface Projects. In this role, she will handle project management, planning, and reporting activities; coordinate and direct subcontractor activities; and ensure successful completion of the project on schedule and budget. Ms. Livers-Douglas has served as PI on several commercial CCS projects and as task lead on DOE projects at the EERC. She has broad expertise in CO_2 geologic storage, including geologic site characterization, regulatory compliance, and North Dakota UIC Class VI permitting and will help guide project activities.

Each of the proposed tasks will be led by qualified individuals from the EERC who will work with the project partners as appropriate to accomplish task goals and corresponding project goals. Key personnel are listed in Figure 1, and resumes of key personnel are provided in Appendix D. The project team also includes multiple project advisors with decades of combined CCS experience and/or relevant industry experience who will support the PI. Three project advisors from project partners, Neset and REC, will also advise the PI on technical and nontechnical issues to effectively meet the proposed project goals and timelines.

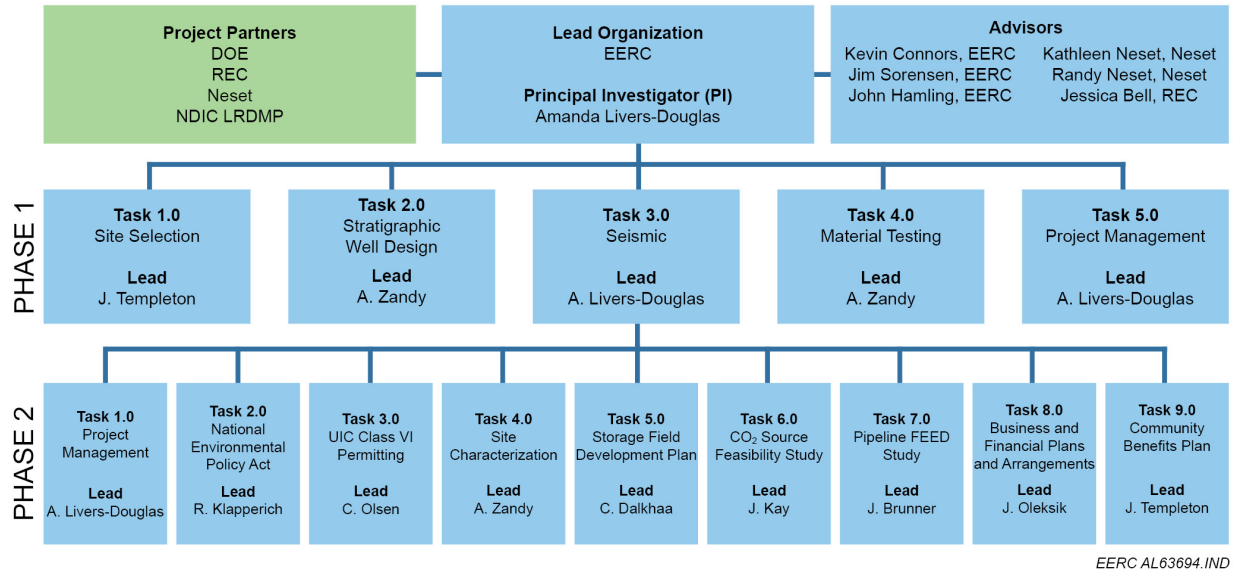

Figure 1. Project organizational chart showing key personnel.

The EERC has the experience and capabilities necessary to lead and carry out the proposed project through a wide variety of previous work. The research, field experience, and partnership investment that have been built through the EERC-led Plains CO_2 Reduction (PCOR) Partnership enable the EERC to confidently propose and execute the proposed project. The PCOR Partnership has covered all aspects of developing CO_2 storage projects and has led directly to developing new CCS storage programs in the region. For example, the EERC worked with Red Trail Energy to obtain a UIC Class VI storage facility permit and assisted with implementing the project, which became operational in June 2022. Red Trail Energy's Class VI permit was the first issued by the state of North Dakota and the third issued in the United States. Additionally, the EERC led DOE CarbonSAFE Phase II and Phase III projects in partnership with Project Tundra which resulted in UIC Class VI storage facility permits to accommodate 4 MMt/year of geologic storage for another lignite power generation facility in North Dakota, Milton R. Young Station. Additionally, the EERC has been exploring development of CCS around Blue Flint Ethanol and Coal Creek through prefeasibility, feasibility, and site characterization studies in collaboration with

MAG since 2019. Also, the EERC conducted a pre-FEED capture study and is currently leading a capture FEED study at Coal Creek in collaboration with REC.

REC owns and operates Coal Creek and has committed to developing the world's largest postcombustion CO_2 capture facility, which will capture 95% of Coal Creek's CO_2 emissions, totaling 8.9 MMt/year. This substantial investment in resources and infrastructure goes hand in hand with the proposed effort to characterize and develop the CO_2 storage resources for the site. REC also has strategic partnerships outside of the proposed work that are key to the success of the larger CO_2 capture and storage program. REC has agreements in place with MAG to utilize geologic and demographic information collected by MAG to advance development of CCS at Coal Creek. REC's partnership with NACCO provides the land access necessary to characterize and permit the storage complex site proposed by this work. Finally, REC has committed to providing the appropriate cost share and resources necessary to complete the proposed effort, as described in its letter of support (Appendix C).

Neset has provided drilling, production, and geological consulting services to operators in the Williston Basin for over 40 years. Neset will provide the resources and know-how to plan, permit, and complete characterization wells to be drilled as part of this proposed effort. Neset's consultants will ensure high-quality data and samples are collected from the characterization wells and use their experience to maximize the successful collection of samples and data from multiple horizons. Neset has committed to providing the appropriate personnel and resources needed for the project as described in its attached letter of support.

The EERC and Neset are currently partnered on efforts funded by the state of North Dakota to characterize the potential to develop underground storage of natural gas and related gases in subsurface salt formations. Through these efforts, the EERC and Neset have experience in working together to budget, plan, and carry out well-drilling, coring, and logging activities in the Williston Basin, experience that is directly applicable to the proposed effort.

VALUE TO NORTH DAKOTA

Establishment of CCS at Coal Creek will reduce 95% of the CO_2 emissions from the plant, which represents a 19% reduction of CO_2 from North Dakota's stationary sources, providing an important step in helping reach Governor Burgum's goal for North Dakota to achieve net-zero carbon emissions by 2030. Capturing emissions from coal-based processes at REC will remove greenhouse gases that would otherwise enter the atmosphere; improve resiliency of Coal Creek against future legislation, regulations, and/or taxes associated with carbon emissions; allow Coal Creek to continue to provide safe, reliable, affordable, and environmentally prudent baseload energy; and contribute to continued energy independence in domestic markets. If future project phases are realized and the project is ultimately implemented, the life of the plant will be extended, ensuring continued quality jobs in the region. Coal Creek and NACCO's Falkirk Mine, which feeds the plant, support 700 direct/indirect jobs. Development of CCS at Coal Creek will result in approximately 35 to 40 direct long-term jobs and over 2000 direct/indirect short-term construction jobs.

Additionally, results from the project including subsurface data and information related to the storage capacity and technical challenges associated with CO_2 storage in carbonates will greatly benefit other CCS project developers in North Dakota. This information will be made publicly available through the NDIC Department of Mineral Resources (DMR) website and project reports, and can be used to support the development of future projects.

MANAGEMENT

The project team comprises researchers from the EERC and staff and project advisors from Neset and REC. The EERC will schedule regular internal and external meetings with project staff and advisors to ensure that the project is conducted using acceptable scientific methodologies and practices in accordance with the project plan (budget, schedule, deliverables, and milestones) and is meeting quality objectives. The EERC will keep all partners informed of project progress and coordinate activities as

necessary for the execution of a successful project and will be responsible for timely submission of all project deliverables and transfer of data and products to the team.

REC will coordinate efforts to support site characterization activities, including providing access to land within the area of interest and existing characterization data. REC will also assist with NEPA documentation and business financial plans and arrangements.

Neset will serve as primary point of contact for obtaining quotes and materials for drilling operations and help plan and participate in community outreach events.

Project progress will be measured by completion of milestones and deliverables as noted in the project timeline in Figure 2. The milestones and deliverables are at key times during the design, site characterization, permitting, and commercial development components of the project. The deliverables are indicated where key documents and reports are noted, while the milestones are noted as key accomplishments during the project's progress. Quarterly reports will be provided to LRDMP throughout the duration of the project. A final report for Stage 1 and Stage 2 will be provided in addition to interim reports including a geologic catalog of materials, detailed site and subsurface characterization storage resource/capacity assessment, and UIC Class VI storage facility permit application(s).

TIMETABLE

The project timeline for Stage 1 and Stage 2 can be found in Figure 2a and 2b. The project is scheduled for 39 months, with a projected start date of June 2023.

Figure 2a: Project Gantt chart for Stage 1.

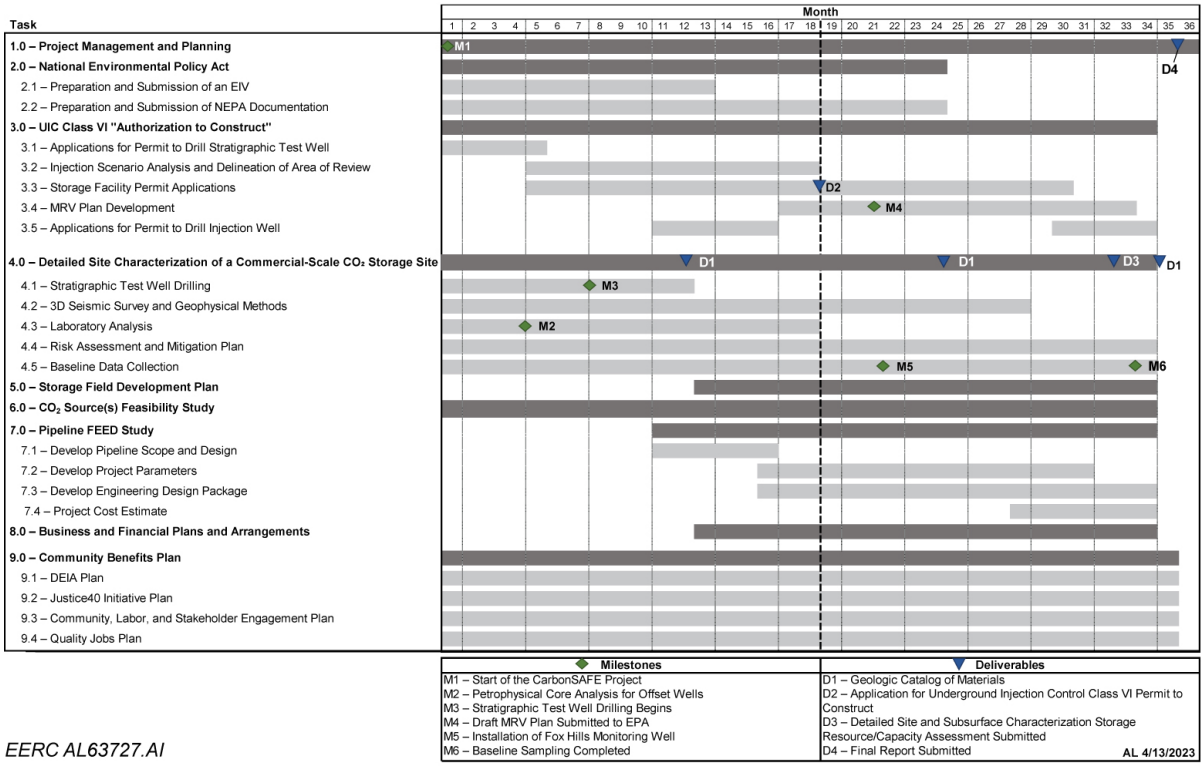

Figure 2b: Project Gantt chart for Stage 2. Note: deliverables for Stage 2 are prescribed by DOE.

BUDGET AND MATCHING FUNDS

Table 1 shows a summary of the proposed budget. Letters of commitment for the cost share from REC can be found in Appendix C. Budget notes can be found in Appendix E. If less funding is available than requested, changes to the scope will be considered.

TAX LIABILITY

The EERC, a department within the University of North Dakota, is a state-controlled institution of higher education and is not a taxable entity; therefore, it has no tax liability.

CONFIDENTIAL INFORMATION

Confidential Information is contained in Appendices A and B.

REFERENCES

Stanislowski, J.J.; Folkedahl, B.C.; Jensen, M.D.; Musich, M.A. *Regional Impacts of Carbon Capture and Sequestration in the State of North Dakota*; Final Report for Lignite Energy Council; EERC Publication 2019-EERC-02-07; Energy & Environmental Research Center: Grand Forks, ND, Feb 2019.

Table 1. Budget Breakdown

Project-Associated Expense	NDIC STAGE 1 Share (cash)	REC STAGE 1 Share (cash)	NDIC STAGE 2 Share (cash)	REC STAGE 2 Share (cash)	DOE STAGE 2 Share (cash)	NDIC Project Share (cash)	REC Project Share (cash)	Total Project
Labor	$178,342	$333,221	$0	$0	$9,344,930	$178,342	$333,221	$9,856,493
Travel	$489	$716	$0	$0	$274,148	$489	$716	$275,353
Equipment > $5000	$0	$0	$0	$0	$7,832	$0	$0	$7,832
Supplies	$380,559	$226,810	$0	$0	$966,449	$380,559	$226,810	$1,573,818
Subcontractor – Neset	$0	$16,500	$0	$0	$0	$0	$16,500	$16,500
Subcontractor – Stress Engineering	$410,000	$0	$0	$0	$0	$410,000	$0	$410,000
Subcontractors – DOE Award	$0	$0	$4,769,690	$4,754,691	$18,420,767	$4,769,690	$4,754,691	$27,945,148
Rental	$0	$0	$0	$0	$600	$0	$0	$600
Repairs	$0	$0	$0	$0	$2,200	$0	$0	$2,200
Contract Services – TetraTech	$0	$255,000	$0	$0	$0	$0	$255,000	$255,000
Contract Services – Earth Signal Processing	$46,765	$0	$0	$0	$0	$46,765	$0	$46,765
Communications	$0	$25	$0	$0	$970	$0	$25	$995
Printing & Duplicating	$0	$289	$0	$0	$1,870	$0	$289	$2,159
Food	$0	$0	$0	$0	$21,240	$0	$0	$21,240
Professional Development	$0	$0	$0	$0	$6,400	$0	$0	$6,400
Freight	$0	$0	$0	$0	$2,500	$0	$0	$2,500
Laboratory Fees & Services								
EERC Natural Materials Analytical Research Lab	$0	$0	$0	$0	$558,005	$0	$0	$558,005
EERC Process Chemistry & Development Lab	$0	$0	$0	$0	$30,816	$0	$0	$30,816
EERC Document Production Services	$7,051	$2,350	$0	$0	$397,758	$7,051	$2,350	$407,159
EERC Shop & Operations	$0	$0	$0	$0	$10,199	$0	$0	$10,199
EERC Software Solution Services	$0	$3,283	$0	$0	$6,591	$0	$3,283	$9,874
EERC Engineering Services Fee	$0	$98	$0	$0	$37,229	$0	$98	$37,327
EERC Field Safety Fee	$418	$0	$0	$0	$104,094	$418	$0	$104,512
EERC Geoscience Services Fee	$448	$5,458	$0	$0	$111,851	$448	$5,458	$117,757
Outside Labs	$0	$0	$0	$0	$1,090,952	$0	$0	$1,090,952
Total Direct Costs	$1,024,072	$843,750	$4,769,690	$4,754,691	$31,397,401	$5,793,762	$5,598,441	$42,789,604
Facilities & Administration	$325,928	$506,250	$0	$15,000	$6,751,119	$325,928	$521,250	$7,598,297
Total Cash Requested	**$1,350,000**	**$1,350,000**	**$4,769,690**	**$4,769,691**	**$38,148,520**	**$6,119,690**	**$6,119,691**	**$50,387,901**

CONFIDENTIAL

APPENDIX A

CONFIDENTIAL INFORMATION REQUEST

*This is a confidential document pursuant to 54-63.1-06.

Request for Confidentiality

A person or entity may file a request with the Commission to have material(s) designated as confidential. By law, the request is confidential. The request for confidentiality should be strictly limited to information that meets the criteria to be identified as trade secrets or commercial, financial, or proprietary information. The Commission shall examine the request and determine whether the information meets the criteria. Until such time as the Commission meets and reviews the request for confidentiality, the portions of the application for which confidentiality is being requested shall be held, on a provisional basis, as confidential.

If the confidentiality request is denied, the Commission shall notify the requester and the requester may ask for the return of the information and the request within 10 days of the notice. If no return is sought, the information and request are public record.

Note: Information wished to be considered as confidential should be placed in separate appendices along with the confidentiality request. The appendices must be clearly labeled as confidential. If you plan to request confidentiality for **reports** if the proposal is successful, a request must still be provided.

Applicant: Energy & Environmental Research Center (EERC)
Application Title: Coal Creek Carbon Capture: Geologic CO_2 Storage Complex Development

Please provide the following information. Use additional pages if more space is needed.

1. A general description of the nature of the information sought to be protected.

   A detailed description of the tasks to be performed as part of the proposed project.

2. An explanation of why the information derives independent economic value, actual or potential, from not being generally known to other persons.

   The detailed description of the proposed tasks for Stage 2 is a direct excerpt from the pending proposal the EERC submitted to the U.S. Department of Energy (DOE) CarbonSAFE Initiative competitive funding opportunity. The information was formulated to address the proposal requirements, and the EERC could lose potential competitive advantage for this funding as proposals are still being accepted for this funding opportunity.

3. An explanation of why the information is not readily ascertainable by proper means by other persons.

   The EERC does not readily disclose this information while proposals are pending decision.

4. A general description of any person or entity that may obtain economic value from disclosure or use of the information, and how the person or entity may obtain this value.

Consulting companies, site operators, or other research institutes looking to apply for funding through the CarbonSAFE Initiative.

*This is a confidential document pursuant to 54-63.1-06.

5. A description of the efforts used to maintain the secrecy of the information.

The EERC employs strict confidentiality policies and procedures for handling and maintaining its confidential information. The information will not be further disclosed outside of the project team until the DOE proposal is awarded and a contract is in place with DOE.

CONFIDENTIAL

APPENDIX B

PROPOSED TASKS

PROPOSED TASKS

STAGE 1

The proposed Stage 1 scope of work (SOW) includes activities necessary to plan and design a stratigraphic test well to characterize the targeted geologic carbon dioxide (CO_2) storage complex; the Broom Creek, Interlake, Red River, and Deadwood Formations; and associated upper and lower confining zones. To inform site selection for the stratigraphic test well and support the well design, the geologic storage complex will be evaluated for the ability to geologically store up to 200 million metric tons (MMt) of CO_2, to be injected over 20 years. Prior regional characterization work conducted by the Energy & Environmental Research Center (EERC) will be leveraged to inform site selection through reservoir simulation and location-specific screening. Additionally, the EERC has identified existing two-dimensional (2D) seismic data in the project area that are available for licensing. Interpretation of the 2D seismic data will be used to support the stratigraphic test well site selection and design of the three-dimensional (3D) seismic survey. A 3D seismic survey design will be provided as a deliverable of this SOW. Stage 1 is divided into five tasks: 1) site selection, geologic modeling, and simulations; 2) stratigraphic well design; 3) seismic acquisition design and planning; 4) material recommendation and testing; and 5) project management. Proposed tasks are described below.

Task 1.0 – Site Selection

The EERC will leverage available geologic data and existing geologic models to perform reservoir simulations for the proposed CO_2 storage scenarios (i.e., well locations, rates/duration). The location and estimated extent of the CO_2 storage facility project footprint will be evaluated relative to the Rainbow Energy Center (REC) development scenario, the provisional location of the 3D seismic survey, and the site-screening criteria derived for Task 3.0 to select a provisional location for the stratigraphic test well.

Subtask 1.1 – Geologic Models

Existing geologic models of the Broom Creek, Red River, and Deadwood Formations will be evaluated for their suitability for this project. Models will be updated to fit the needs of the project. A new geologic model will be constructed using available geologic data for the Madison and the Interlake Formation. The geologic model interpretation (e.g., lateral and vertical heterogeneity, uncertainty, etc.) along with key assumptions will be captured, summarized, and reviewed with REC. The geologic models will provide the foundation for property distribution for subsequent numerical simulations in Subtask 1.2. These models will be updated in the future as part of the U.S. Department of Energy (DOE)-funded "Coal Creek CarbonSAFE Phase III: Site Characterization and Permitting" project (CarbonSAFE Phase III project) to include characterization data collected from acquisition of 3D seismic data and drilling, coring, and testing the stratigraphic well and the MAG 2 well.

Subtask 1.2 – Simulation

Numerical reservoir simulations for the prospective storage complex (target storage reservoirs and associated confining zones) will be conducted using Computer Modelling Group Ltd.'s (CMG's) GEM dynamic simulation module. The simulations will integrate available petrophysical and hydrological data and the property distributions from the geologic models constructed in Subtask 1.1 to evaluate storage capacity and predict CO_2 plume and pressure plume extents.

Simulations will be conducted for a range of potential injection scenarios to evaluate storage performance and inform site selection based on criteria provided by REC (i.e., preferred location of injection well[s], injection rates, duration of injection, injection well specifications, injection pressure

design, and potential pressure interference considerations, etc.). The results of these scenarios will be captured, summarized, and reviewed with REC. Based on the REC-selected development scenario and design basis, a matrix of simulations will be performed. The results of the simulations will inform project design parameters.

Task 2.0 – Stratigraphic Well Design

The EERC will facilitate and support the design, bidding, and planning for a stratigraphic test well. Subsequent execution of drilling, logging, coring, well testing, monitoring, and completion of the stratigraphic test well is anticipated to be done under the CarbonSAFE Phase III project.

The EERC has identified Neset Consulting Service, Inc. (Neset) to serve as the general drilling contractor (GDC) on the stratigraphic test well and subsequent project wells (i.e., monitoring or injection well). The EERC will collaborate with a third party and Neset to generate a draft drilling plan to facilitate the development of an authorization for expenditures (AFE) for the stratigraphic test well. This AFE will include the design, drilling, coring, logging, testing, installation of monitoring systems, and completion of the stratigraphic test well. The well will be designed so that it can be transitioned for future use as a UIC Class VI injection well. The AFE will be provided to REC for authorization and subsequent execution as part of the CarbonSAFE Phase III project.

The proposed SOW and associated budget DOES NOT include contracting, permitting, drilling, coring, logging, testing, monitoring equipment installation, completion, or site support for the stratigraphic test well. These funds are included in the Stage 2 budget.

Task 3.0 – Seismic

The EERC has identified existing 2D seismic data sets within the area of interest surrounding Coal Creek Station (Coal Creek). The EERC will purchase existing 2D data up to 130 miles. These 2D data will be used to inform site selection, stratigraphic well design, and design of a 3D seismic survey. 3D seismic data are required to characterize structural features in the subsurface to a level of detail needed to evaluate potential fluid migration pathways and structures that may pose risk for induced seismicity. The North Dakota Industrial Commission (NDIC) will likely require evaluation of site-specific 3D seismic data to permit the Deadwood Formation as an injection zone. The EERC will generate a preliminary 3D seismic survey design, prepare request for proposal for the acquisition of the 3D survey, solicit bids, and review bid packages.

Task 4.0 – Material Recommendation and Testing

The EERC, through the cooperation of a third-party subject matter expert, Stress Engineering, will determine the material requirements for the stratigraphic well, injection wells, and pipeline used for the transportation and injection of the CO_2 stream from Coal Creek and other identified facilities. Stress Engineering will review the pertinent details of the project, to include but not be limited to pressure, temperature, and composition of the CO_2 stream; temperature, pressure, and water analysis or other pertinent information from each proposed injection zone; and CO_2 stream compatibility with the well tubulars and pipeline as directed. Stress Engineering will provide a list of recommended materials based on public data, Stress Engineering experience in carbon capture and storage (CCS) projects, and information requested and supplied from this project. In addition, Stress Engineering will provide material specification to be used for the acquisition of the recommended materials and a recommendation if testing of the recommended materials would be required to validate the material selection for the intended use. If material testing is recommended, Stress Engineering will provide the

modeling and testing protocol for conducting 30- and 90-day test programs as well as oversee the testing of the recommended materials.

Subtask 4.1 – Project Management, Planning, and Reporting

Stress Engineering will manage and direct Task 4.0 to meet all the technical, schedule, and budget objectives and requirements. Stress Engineering will coordinate the activities to effectively accomplish the work and will ensure that project plans, results, and decisions are appropriately documented and project reporting and briefing requirements are satisfied.

Subtask 4.2 – Material Recommendation

Recommendations for the material selection will be provided as well as material specifications for the acquisition of the recommended materials based on the preliminary and final composition of the CO_2 stream provided. Stress Engineering will document and provide cost estimates and timing for the following items:

- Review the CO_2 stream and the conditions required for the injection of the CO_2 into the target formation(s), water analyses, reservoir conditions, operating conditions, or other pertinent information regarding the selection of materials within the stratigraphic well, injection wells, and pipeline as directed.
- Provide material specifications for the acquisition of the recommended materials.
- Provide a list of vendors and contact information that can supply the recommended materials.
- Provide support and review of responses from prospective vendors concerning material acquisition.
- Provide a list of alternative materials if lead time(s) for the recommended materials is determined to be prohibitively long.

Subtask 4.3 – Material Testing

Based on the findings of Subtask 4.2, a determination will be made on whether material testing is required to validate the selection of the materials for the CCS project. If material testing is recommended, Stress Engineering will do the following (at a minimum):

- Provide the modeling and testing protocol (for both 30- and 90-day testing periods) for the conditions that the recommended materials will be exposed to during the operation, injection, and postinjection periods of this project or other needs of the project.
- Provide a list of recommended labs and contact information for conducting the material testing.
- Assist with the evaluation of the responses from labs for the material testing.
- Oversee the testing program to ensure that the material testing is conducted and completed in a best-of-class scenario and will adhere to the indicated test procedures and timing from the prospective labs.

- Provide a summary of the results of the material testing, in particular, whether the material would be suited for the intended use.

Task 5.0 – Project Management

The EERC will provide regular updates, quarterly reports, and a final project report and participate in virtual and/or in-person meetings to brief the NDIC Lignite Research, Development and Marketing Program (LRDMP) and other project partners on project status; solicit necessary input from project partners to accomplish project tasks; address challenges and facilitate decision points, action items, accomplishment of the SOW, and commensurate timeline; and budget estimates. Regular internal project management, planning, and execution meetings will be held with relevant technical personnel, technical advisors, task leads, project coordinators, and leadership to facilitate timely progress and execution of the SOW.

The EERC will also participate in calls, virtual meetings, and in-person meetings with project partners, stakeholders, and contractors as appropriate or otherwise requested by NDIC LRDMP. Task leads, project coordinators, and project advisors will be employed to provide timely communication, coordination, project execution, and quality assurance/quality control of products and deliverables.

STAGE 2

The Stage 2 SOW was designed to advance development of a large-scale commercial geologic CO_2 storage hub through site characterization and permitting of a geologic storage complex in central North Dakota to store up to 200 MMt of CO_2 and fulfill the goals of DOE's CarbonSAFE (Carbon Storage Assurance Facility Enterprise) Initiative Phase III program. The objectives of the first 18 months of Stage 2 are to fully characterize the proposed storage complex, prepare and submit underground injection control (UIC) Class VI permit applications and U.S. Environmental Protection Agency (EPA) National Environmental Policy Act (NEPA) documentation, and implement a community benefits plan (CBP) to engage a diverse, inclusive set of community stakeholders and help build the values of diversity, equity, inclusion, and accessibility (DEIA); environmental justice; broad-based community engagement; and worker support more deeply into all project activities. The objectives of the second 18 months of Stage 2 are to compile the necessary information to inform the final investment decision and prepare the project for transition into a commercial CCS project through completion of a pipeline front-end engineering and design (FEED) study and finalization of a storage field development plan and business and financial plans and arrangement. Proposed tasks as prescribed by DOE are described below.

Task 1.0 – Project Management and Planning

The Recipient shall manage and direct the project in accordance with a Project Management Plan (not included in this proposal) to meet all technical, schedule and budget objectives and requirements. The Recipient will coordinate activities in order to effectively accomplish the work. The Recipient will ensure that project plans, results, and decisions are appropriately documented and project reporting and briefing requirements are satisfied.

The Recipient shall update the Project Management Plan 30 days after award and as necessary throughout the project to accurately reflect the current status of the project. Examples of when it may be appropriate to update the Project Management Plan include: (a) project management policy and procedural changes; (b) changes to the technical, cost, and/or schedule baseline for the project; (c) significant changes in scope, methods, or approaches; or (d) as otherwise required to ensure that the plan is the appropriate governing document for the work required to accomplish the project objectives.

Management of project risks will occur in accordance with the risk management methodology delineated in the Project Management Plan in order to identify, assess, monitor and mitigate technical uncertainties as well as schedule, budgetary and environmental risks associated with all aspects of the project. The results and status of the risk management process will be presented during project reviews and in quarterly progress reports with emphasis placed on the medium- and high-risk items.

The Recipient shall participate in cross-project working groups once the working groups are established by the National Energy Technology Laboratory (NETL).

Task 2.0 – National Environmental Policy Act (NEPA)
The Recipient will perform all work elements required to obtain a NEPA determination for the proposed site(s) and support the required NEPA review process.

Subtask 2.1 – Preparation and Submission of an Environmental Information Volume (EIV)
The Recipient will complete an EIV to assess any NEPA-related issues at the chosen site(s). The purpose of the EIV, http://netl.doe.gov/File%20Library/Business/forms/451_1-1-6.pdf, is to initiate analysis of the chosen capture, transportation, and storage site(s) from a NEPA perspective. The completed EIV will provide all initial environmental data and details about the proposed actions to take place through the postinjection site care period.

Subtask 2.2 – Preparation and Submission of NEPA Documentation
Following NEPA review of the EIV, the Recipient will prepare the documentation required for the probable NEPA class of action (Categorical Exclusions, Environmental Assessment or Environmental Impact Statement). The recommended documentation will be submitted to NEPA.

Task 3.0 – UIC Class VI Authorization to Construct
This task encompasses the activities required to develop permitting documents necessary to characterize, construct, and operate a commercial geologic storage hub including applications for permits to drill the proposed stratigraphic test well and injection wells required for the project, UIC Class VI permit applications, and a monitoring, reporting, and verification (MRV) plan to meet the requirements of the federal 45Q tax incentive program as administered by the Internal Revenue Service (IRS).

Subtask 3.1 – Application for Permit to Drill a Stratigraphic Test Well
This subtask will entail development of an application for permit to drill (APD) the stratigraphic test well. The APD will include the well location, formation characterization plan, and well completion program for the stratigraphic test well to meet the UIC Class VI CO_2 injection well standards. Once sampling and logging processes are completed, the stratigraphic test well will be temporarily abandoned, according to procedures and regulations established by NDIC.

Subtask 3.2 – Injection Scenario Analysis and Delineation of Area of Review
This subtask will include the modeling and simulation activities necessary to determine the injection scenario to be permitted, delineate the area of review (AOR), and address North Dakota UIC Class VI requirements. Geologic data collected in Task 4.0 will be used to create new or update existing geologic models of the proposed study area using industry-standard software. The models will integrate the known and acquired geologic, structural, and fluid data of the study area (for both the reservoir and confining zones) of up to four potential geologic storage zones and upper dissipation zone. These models may be used to assess seal effectiveness in CO_2 containment, CO_2 density under reservoir

conditions, CO_2 storage resource, both lateral and vertical geologic heterogeneity (as interpreted from 3D seismic data), and other data necessary to develop Class VI UIC permits. The geologic models will also provide the foundation for dynamic simulation of potential injection scenarios.

Dynamic simulations of the geologic models will be used to estimate the distribution and extent of the CO_2 plumes (totaling 200 MMt). Simulation models will be developed using CMG software. Injectivity of the storage complex will be assessed to evaluate the behavior of the injected CO_2 at the project site and inform number of injection wells needed. Results will inform decisions on injection strategies. Results will be used to help develop components of the Class VI permit documents, including CO_2 injection plans; CO_2 monitoring, verification, and accounting (MVA) plans; evaluations of legacy wellbores; and emergency response strategies. Simulation results and injection plume extents developed will be used to delineate the AOR of the proposed CO_2 storage program.

To address the North Dakota UIC Class VI regulations related to compatibility of the CO_2 stream with fluids and minerals in the injection and the confining zone, geochemical simulations will be used to evaluate geochemical interactions between rock fluid and minerals and injected CO_2 injection stream and understand the compatibility of the injected stream and its impact on the storage formations to ensure safe and permanent storage of CO_2 at the storage site. A multiphase, multicomponent reactive fluid flow simulation will be performed using industry-standard software which implements a fully coupled approach to handle the phase and chemical equilibrium and rate-dependent mineral dissolution/precipitation in the CO_2 injection and storage processes.

To address requirements related to geomechanical information from the confining zone, one-dimensional (1D) and 3D mechanical earth models (MEMs) will be constructed for the stratigraphic well. Modular formation dynamics testing (MDT) data, image logs, sonic scanner geomechanical data, and results from mechanical strength testing performed on core samples generated in Task 4.0 will be used as inputs for this analysis. Discrete zones and layers with facies and local deformation mechanisms will be used to construct the model's mechanical stratigraphy. Mechanical properties and stress states from lab, field measurement, seismic data, and simulated CO_2 injection will be used to populate and calibrate the model. Failure analysis for wellbore stability and fracture characterization will be performed, and in situ stresses from field observations and lab testing results will be verified. The fully coupled 3D MEM dynamic simulation volume will be used for predicting the effects of pore pressure changes on stress evolution and rock failure stability.

Subtask 3.3 – Storage Facility Permit Applications

This subtask includes all work necessary to compile, prepare, and submit up to eight North Dakota UIC Class VI storage facility permit applications. The data and information necessary to assemble the permit applications will be generated in Subtask 3.3 and Task 4.0, including the geologic and hydrogeologic evaluation, geochemical modeling, geomechanical modeling, and computational modeling conducted to predict the extent of the CO_2 plume(s) and determine the AOR(s). Computation modeling results will be used to inform the operating parameters to be permitted, such as average and maximum injection rates, daily injection volume, average operating injection pressure, maximum allowable injection pressure, and total volume of CO_2 to be stored throughout the operational life of the storage facility. The characterization data and AOR(s) will be used to perform an evaluation of all potential leakage pathways and delineated as part of the storage facility permit(s). This evaluation will include a review of all legacy wellbores within the AOR(s). The CO_2 source study from Task 6.0 and pipeline FEED study from Task 7.0 will provide data needed to fulfill Class VI regulatory requirements related to describing and handling

the CO_2 to be injected. Business and financial plans from Task 8.0 will also provide the foundation of the financial responsibility demonstration required for Class VI permits.

This subtask also includes the development of the following documents and plans as required for the storage facility permit(s): 1) an emergency and remedial response plan, 2) a worker safety plan, 3) a financial responsibility demonstration, 4) a corrosion monitoring and prevention plan for all wells and surface facilities, 5) a leak detection and monitoring plan for all wells and surface facilities, 6) a leak detection and monitoring plan to monitor the CO_2 in the storage reservoir, 7) well casing and cementing programs, 8) a testing and monitoring plan, 9) an AOR and corrective action plan, 10) an injection well-plugging plan, and 11) a postinjection site care and monitoring plan. Additionally, the Recipient will collaborate with project partner legal counsel to identify and generate maps of pore space and mineral ownership within the project boundaries for the required Class VI hearing notification process.

Subtask 3.4 – MRV Plan Development

This subtask will be conducted to develop an EPA Greenhouse Gas Reporting Program (GHGRP) Subpart RR-compliant MRV plan to meet the requirements of the IRS 45Q tax incentive program. The MRV plan will be developed concurrently with the Class VI permit applications' testing and monitoring plans and will be compliant with the North Dakota Class VI UIC reporting requirements.

Subtask 3.5 – Class VI Permit Applications

This subtask includes all necessary permitting work to obtain approval to construct and operate all required Class VI injection wells in the storage complex. Injection wells will be designed to meet or exceed the Class VI requirements. Applications to drill will be compiled, prepared, and submitted to ensure all regulatory approvals have been obtained to begin CO_2 injection operations. As part of this subtask, engineered well designs will be generated for up to 17 injection wells to support preparation of the storage facility permit applications and applications to drill and construct the Class VI injection wells.

Task 4.0 – Detailed Site Characterization of a Commercial-Scale CO_2 Storage Site

This task encompasses the activities required to perform geologic characterization of up to four potential storage reservoirs (e.g., Broom Creek, Interlake, Red River, and Black Island–Deadwood Formations), their associated upper and lower confining zones, and overlying pressure dissipation zone, the Inyan Kara Formation. Existing geologic and hydrogeologic evaluations will be updated based on new data derived from analysis of new core, subsurface fluid samples, and well logs and the acquisition and processing of a 3D seismic survey. Data acquired and analyzed during this task will be used in the development of Task 5.0 – Storage Field Development Plan and Task 3.0 – UIC Class VI Authorization to Construct.

Subtask 4.1 – Stratigraphic Test Well Drilling

This subtask will entail drilling one geologic characterization well (stratigraphic test well) near Coal Creek through all the potential storage zones to the Precambrian basement rock. Whole or sidewall core will be collected from the upper/lower confining layers and reservoir intervals of up to four potential storage zones: the Broom Creek, Interlake, Red River, and Black Island–Deadwood Formations, and overlying pressure dissipation zone, the Inyan Kara. A comprehensive logging suite will be collected to fulfill the UIC Class VI logging requirements and inform the petrophysical, geophysical, and lithologic properties for the zones of interest for incorporation into Subtask 3.3.

Subtask 4.2 – 3D Seismic Survey and Geophysical Methods

The Recipient will permit and conduct a 3D seismic survey over the area of interest located near Coal Creek. Up to 314 mi^2 of 3D seismic data will be acquired over the area of interest to evaluate the heterogeneity and thickness of the target storage zones and associated upper and lower confining zones and to assess subsurface structure that may impact migration of CO_2 within and out of the storage zone such as four-way closures or faults. The Recipient will lead seismic processing and interpretation of the 3D seismic data. Rock physics analysis and petrophysical modeling will be performed as inputs for seismic inversion (Vp, Vs, density, and Vp/Vs), which will be used to derive high-resolution rock properties that will be integrated into the geologic model and geomechanical model in Subtask 3.3. This 3D seismic survey will also serve as a baseline survey for future site monitoring during the operation phase of the storage hub. To that end, the seismic survey design will include a compressive sensing component which will facilitate sustainable and cost-efficient options for future monitoring surveys.

For additional regional structural characterization, the reservoir and cap rock zones of interest will be further characterized through analysis of existing geophysical data. These additional geophysical data may include legacy seismic data and regional gravity and magnetic data acquired from public sources or licensed as appropriate. Legacy and newly acquired geophysical data will be interpreted to identify geologic structural and stratigraphic relationships and geologic heterogeneity within the study area.

Subtask 4.3 – Laboratory Analysis

This subtask includes testing and analysis of core and fluid samples collected in Subtask 4.1. Several geochemical, petrographic, petrophysical, and geomechanical analyses will be performed on core and fluid samples to better understand factors that influence the long-term containment of CO_2, to aid in the calibration and correlation of well logs, and to improve the accuracy of geologic and simulation models. Analytical techniques will provide direct insight regarding the pore-size distribution of the target reservoir and upper/lower confining layers, potential for two-phase flow in a system dominated by high-salinity brine, zones of heterogeneity within the reservoir, and major and minor mineral phases. Geomechanical experiments conducted in this task will focus on mechanical strength testing and will be interpreted to determine the integrity of the confining layers.

Subtask 4.4 – Risk Assessment and Mitigation Plan

A preliminary risk assessment will be conducted for the storage project. Risk assessment is an iterative process that includes 1) risk identification, 2) risk analysis, 3) risk evaluation, and 4) risk treatment. Risk identification will be conducted to identify risks that would prevent potential candidate storage reservoirs within the study areas from serving as commercial storage sites. For each risk, the risk analysis will integrate the best available knowledge and scientific reasoning to determine the likelihood of the risk occurring and the severity of the impact should the risk occur. The Recipient will build on extensive experience using the National Risk Assessment Partnership (NRAP) suite of tools to further validate NRAP tools in a commercial project application. Modeling and simulation outputs generated in Task 5.0 will be used as inputs to the NRAP tool testing. In addition, CO_2 injection simulations developed in Subtask 5.2 using CMG's GEM dynamic simulation module will be used as inputs to NRAP visualization tools, allowing comparisons between a commercial product and the NRAP tool outputs. The technical insights gained through NRAP tool testing will be documented and communicated with DOE. To the extent practical, the NRAP tools will be used as heuristic tools to quantify uncertainty and inform decisions about the potential risks to underground sources of drinking water (USDWs) from legacy wellbore leakage in the AOR.

Risk evaluation will include an uncertainty assessment to evaluate the variability in the risk likelihood and impact scores from the risk analysis. Outliers, or unusually low or high scores, will trigger follow-up evaluation. The project team will define risk thresholds to identify high-ranking risks that warrant treatment or further analysis. After the risk evaluation, a risk treatment strategy will be formulated. Risk treatment includes several different risk management strategies, including avoidance, transfer, mitigation, and acceptance. Risk mitigation plans will be developed should any of these risks materialize.

Communication is necessary during every step of the risk assessment process to assure stakeholders that the risks are being regularly monitored and effectively managed at all stages of the project. To that end, multiple risk documents will be created and shared. An initial risk register will be developed early in the risk identification process to capture general storage project risks. Site-specific information from the site characterization will be incorporated in an updated risk register. Results from Tasks 3.0 and 4.0 will be used in the risk analysis, evaluation, and treatment planning.

Subtask 4.5 – Baseline Data Collection

This task includes the activities necessary to characterize the area of interest and develop monitoring for the resulting AOR as required by Class VI permitting regulations to successfully permit the proposed CO_2 storage complex. This task will identify and screen existing water wells and appropriate surface locations within the AOR to select sampling locations. Selected water wells will be accessed and sampled. Additionally, selected surface locations will be sampled for soil gas composition. Samples will be analyzed for basic geochemical components and isotopes that have demonstrated use for CO_2 site monitoring. One dedicated groundwater-monitoring well will be installed in this task to monitor the lowest USDW, the Fox Hills Formation.

Soil gas and groundwater samples will be collected on a quarterly basis during baseline monitoring (1 year) as part of this task. Soil gas samples will be collected near any known point source (i.e., wellhead or other artificial penetration or leakage pathway) in the project area within the estimated CO_2 plume footprint. Up to 15 soil gas-sampling locations, including one semipermanent soil gas profile station (SGPS), will be installed as part of this task. Groundwater samples will be collected from up to 14 existing wells, in addition to the one newly installed Fox Hills well. There is a wide range of groundwater well depths in the project area (~30–1400 ft). To account for potential varying water chemistries in different depth wells, existing groundwater wells will be screened and selected based on depth and spatial distribution.

Task 5.0 – Storage Field Development Plan

Task 5.0 will combine all the findings and assessments of characterization efforts into a storage field development plan. This plan will define activities that will occur at the site for at least 30 years including injection, postinjection stabilization, and site closure. The progression of storage resource from prospective to capacity, in accordance with the Society of Petroleum Engineers Storage Resource Management System (SRMS), will be included. The plan will include descriptions of development strategy, development schedule, permitting plan, CO_2 transportation design and handling, injection and monitoring operations, and a site closure and postclosure plan. P10, P50, and P90 costs will be estimated over the life of the project, including wells, infrastructure, and monitoring deployment. Project risks and their anticipated effect on cost will be included. A description and diagram of the fully developed field will be used in the storage field development plan and in business plan description. The storage field development plan will consist of two components: the storage development description and rationale for the development plan and the development and management plan.

Task 6.0 – CO_2 Source(s) Feasibility Study

In this task, a plan will be developed to assess the initial supply of CO_2 that would be available for the first 5 years of injection and further develop a plan for the CO_2 supply curve over the next 15 years. The plan will include CO_2 availability over the time frame and quantity from each source, using information from ongoing and existing FEED studies conducted by the Recipient and project partners. Task 6.0 will work closely with Task 3.0 to provide necessary information in support of the application for a Class VI permit. Information will include, but not be limited to, physical and chemical characteristics of the captured CO_2 stream, flow rates, and incoming pressure. This task will also work with Task 7.0 to provide information needed by the CO_2 pipeline providers. Additionally, the study will include information on the methodology of the carbon capture being employed, percent capture, and processing of the incoming flue gas and produced compressed CO_2, including dehydration and compression.

Task 7.0 – Pipeline FEED Study

This task encompasses the activities required to develop the CO_2 pipeline FEED study report, including pipeline design to accommodate the CO_2 stream within the project injection parameters, pipeline site characterization, and pipeline route to connect CO_2 sources to injection wells. The CO_2 stream composition, flow rates, and operating pressure collected from Task 6.0 will be used as inputs for the pipeline FEED study. The information yielded from this FEED study will also be used to supply information for the Subtask 3.2 storage facility permit. Additionally, the study will generate the Association for the Advancement of Cost Engineering (AACE) Class 3 cost estimate and the project timeline. The vast majority of this work will be performed by the FEED study subcontractor and its subcontractors, with the duties of project oversight, post-FEED reporting, and verification falling to the Recipient.

Subtask 7.1 – Pipeline Scope and Design

The Recipient and the subcontractor will work to establish the initial scope and high-level design parameters of the pipeline for carrying the CO_2 stream from the CO_2 sources to the injection wells. These high-level parameters include CO_2 delivery pressure and temperature from the CO_2 sources, pipeline sizing and operating pressure, and additional facility parameters for injection of the CO_2 stream. The process flow diagram (PFD) will be generated based on Task 6.0 study results as well as the results from Task 5.0.

Subtask 7.2 – Project Parameters

This subtask will evaluate the CO_2 stream composition provided from Task 6.0 for its impurities and their effects on the pipeline system. The dehydration needs for the system to accommodate the CO_2 stream within the operating parameters, both in dynamic and static conditions, will be evaluated. Site characterization, permit listing and reviews, land use, right-of-way, utility corridors, property boundaries, and title research will also be conducted. Project environmental, safety, and health (ES&H) criteria including pipeline construction and operational impacts to communities and the environment as well as pipeline failure risk analysis and risk acceptance criteria for pipeline operations will be assessed. The project management plan and risk register and overall project schedule in a Gantt chart will be generated. The information yielded from this subtask will be used to inform the Subtask 3.2 storage facility permit.

Subtask 7.3 – Engineering Design Package

This subtask includes the necessary activities to generate the pipeline route report and maps, design basis document, key design calculations and drawings, critical safety and risk assessments, construction specifications to meet 49 Code of Federal Regulations (CFR) Part 195, and environmental specifications.

These activities will include both on-site surveys as well as desktop studies and designs. The sum of these activities, and the subsequent documents, will constitute the engineering design package.

Subtask 7.4 – Project Cost Estimate

This subtask entails creating a detailed AACE Class 3 cost estimate that is within –10% to +30% of the total costs of pipeline construction.

Task 8.0 – Business and Financial Plans and Arrangements

Task 8.0 encompasses efforts to develop a business plan for the proposed project and support creation of financial plans and arrangements between REC and other stakeholders. Business and financial plans will be developed to address the requirements for a CarbonSAFE Phase IV project. This task will support the development of contracts, agreements, and/or permits as appropriate to support the development and implementation of infrastructure to support the proposed project, working with stakeholders and community members throughout the process. This task will also develop a financial model to demonstrate the financial health and viability of the proposed project when operational. Recipient will collaborate with project partner for development of business and financial plans as entry requirements for CarbonSAFE Initiative Phase IV. The project development and construction schedule, including financial milestones, will be generated. Recipient will collaborate with the project partner to compile any necessary contracts, agreements, and permits as appropriate. The information may include project/construction contracts, site ownership and control documentation, and agreement(s) with stakeholders and affected communities. An Excel-based mathematical model will be generated that describes the future project costs in terms of cash flows.

Task 9.0 – Community Benefits Plan

The plans discussed in Subtasks 9.1–9.4 have unique community focus but are all components of the overarching CBP package and will be implemented concurrently. This approach will not only maximize efficiency and use of materials and resources but also provide consistent trustworthy messaging to enhance existing community relationships and foster new ones. Activities will be tracked throughout the project, logging engagement and feedback to improve plan outcomes and products.

A midpoint project update and presentation will be given to DOE and stakeholders to provide updates on each plan's progress.

Subtask 9.1 – Diversity, Equity, Inclusion, and Accessibility Plan

The DEIA plan included with this proposal describes the actions that will be implemented throughout the project to foster a welcoming and inclusive environment; support people from groups traditionally underrepresented in STEM (science, technology, engineering, and mathematics) and/or applicable workforces; advance equity; and encourage the inclusion of individuals from these groups in future phases of the project. The DEIA plan will be updated according to DOE comment, which may include new impacts, metrics, or ways of processing information. Through feedback on plan implementation, new knowledge, and lessons learned, continual evaluation and updates to the DEIA plan will occur throughout the life of project.

Subtask 9.2 – Justice40 Initiative Plan

The J40 Initiative plan development proposal will be updated within 90 days to create a full J40 Initiative plan. Consisting of two-parts, Part 1 will begin with an in-depth energy and environmental justice assessment (EEJ assessment) that will assess the project stakeholders, benefits, and impacts. Learnings from the EEJ assessment will be used to inform and develop Part 2, the Justice40 implementation

strategy section that will explain actions the project team will take to maximize benefits and minimize negative impacts in areas related to energy and environmental justice. The content of the updated J40 initiative plan will include background, milestones and timeline, assessment of risks and barriers, and a resource summary. Through feedback on plan implementation, regular evaluation, new knowledge, and lessons learned, the J40 initiative plan will be viewed as a living document with continual updates being incorporated throughout the life of project.

Subtask 9.3 – Community, Labor, and Stakeholder Engagement Plan (CLSEP)

The CLSEP development proposal included with this proposal will be updated and implemented to create a full CLSEP. This work will include in-depth social characterization of the project area in the context of the greater region; identification of audiences, including communities with environmental justice concerns, disadvantaged communities, and tribes; developing messaging goals and content; selecting methods for engaging stakeholders (e.g., media campaigns, one-on-one contact, listening sessions, open houses, etc.); strategies for incorporating stakeholder feedback; materials development; developing a timeline for implementation of the plan; and creating a system for tracking engagement outcomes and gauging impact. Through feedback on plan implementation and lessons learned, continual evaluation and updates to the CLSEP will occur through the life of the project.

Subtask 9.4 – Quality Jobs Plan

The quality jobs plan included with this proposal will be updated within 90 days and implemented throughout the life of the project. This effort will include annual training for project team members in CBP-related topics, recruiting for project-related jobs in diverse and disadvantaged communities, and review and benchmarking of human resources (HR) benefits and wages for current and full life cycle project employees. The plan will be regularly evaluated and adjusted as necessary.

APPENDIX C

LETTERS OF SUPPORT

RAINBOW
ENERGY CENTER

2875 Third Street SW
Underwood, North Dakota 58576
701.207.9988
rainbowenergycenter.com

April 13, 2023

Ms. Amanda Livers-Douglas
Assistant Director for Integrated Subsurface Projects
University of North Dakota
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Ms. Livers-Douglas:

Subject: EERC Proposal No. 2023-0147 Entitled "Coal Creek Carbon Capture: Geologic CO_2 Storage Complex Development

I am writing to confirm Rainbow Energy Center's commitment to support the Energy & Environmental Research Center (EERC) in its pursuit of funding from the Lignite Research, Development and Marketing Program (LRDMP) to complete site characterization and permitting for the geologic storage of CO_2 captured as part of commercial-scale CO_2 storage in central North Dakota.

The vision for this carbon capture and storage (CCS) project is to equip Coal Creek Station with a full-scale postcombustion CO_2 capture system that will capture up to 10 million tonnes per year of CO_2 at Coal Creek Station, located between Washburn and Underwood, North Dakota. This equates to approximately 95% of CO2 emissions from Coal Creek Station. When Rainbow Energy Center resolves the financial and technical challenges associated with the commercial deployment of an integrated CCS project, the captured CO_2 is intended to be committed to the geologic storage sites addressed in the proposed effort.

As part of our support and commitment upon award and acceptance of funds, Rainbow Energy Center will support appropriate field site access to Rainbow Energy Center-owned land to facilitate the work described in the application and commits to continue to work toward securing leases needed to conduct these and other related activities in this area.

To demonstrate our support and commitment, should LRDMP and U.S Department of Energy (DOE) funding for the proposed project be awarded and accepted by Rainbow Energy Center, Rainbow Energy Center will contribute up to $6,120,000 in cash cost share with no limitations, restrictions, or contingencies.

We welcome the opportunity to partner with the EERC, Neset Consulting Services, DOE, and LRDMP to establish an integrated CCS project in North Dakota: a project that will ensure wise future development of our state's abundant coal resource and efficient optimization of pore space. If you have any questions, please contact me by telephone or by email.

Sincerely,

Stacy L. Tschider
President

NESET

6844 Highway 40, Tioga, ND 58852 701-664-1492

April 13, 2023

Ms. Amanda Livers-Douglas
Assistant Director for Integrated Subsurface Projects
University of North Dakota
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Ms. Livers-Douglas:

Subject: EERC Proposal No. 2023-0147 Entitled "Coal Creek Carbon Capture: Geologic CO_2 Storage Complex Development

I am writing in support of the Energy & Environmental Research Center's (EERC's) pursuit of carbon capture and storage (CCS) at Coal Creek Station.

Neset Consulting Services, an officially certified Woman-Owned Business and Woman-Owned Small Business, has successfully operated in the Willison Basin from its headquarters in Tioga, ND, for over 40 years, contributing to the successful completion of 7700+ wells. We have worked in collaboration with the EERC to serve as a drilling contractor for multiple UIC (underground injection control) Class VI-compliant appraisal wells to support geologic storage on anthropogenic CO_2. We are committed to providing the staff and resources necessary to support outreach and the drilling, characterization, logging, coring, testing and completion of appraisal well(s) as outlined in the subject proposal.

We welcome the opportunity to partner with the EERC, Rainbow Energy Center, the U.S. Department of Energy, and Lignite Research, Development and Marketing Program to establish an integrated CCS project in North Dakota: a project that will ensure wise, future development of our nation's abundant energy resources. If you would like to discuss, please contact me by telephone or by email.

I look forward to working with you and hope to see this project move forward in North Dakota.

Sincerely,

Kathleen Neset

Kathleen Neset
President, Owner

NACCO NATURAL RESOURCES

November 7, 2022

Ms. Amanda Livers-Douglas
Assistant Director for Integrated Subsurface Projects
University of North Dakota
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Re: CarbonSAFE Site Characterization and Permitting for Commercial-Scale Geologic Carbon Storage in Central North Dakota (DE-FOA-0002711)

Dear Ms. Livers-Douglas:

The North American Coal Corporation, a NACCO company, is committed to support the Energy & Environmental Research Center (EERC) in its response to the subject U.S. Department of Energy (DOE) funding opportunity to complete site characterization and permitting for the geologic storage of CO_2 captured as part of Rainbow Energy Center's emerging commercial-scale CO_2 storage project in central North Dakota.

North American Coal represents one of the largest landowners with pore space ownership within the proposed project area. As part of its support and commitment, North American Coal will support appropriate field site access to North American Coal-owned land to facilitate the work described in the application, should funding for the proposed project be awarded. North American Coal is interested in the potential opportunity to lease pore space for CO_2 storage at this site.

We welcome this opportunity to partner with the EERC, Neset Consulting Service, Rainbow Energy Center, DOE, and the rest of the team pursuing opportunities to resolve challenges associated with the commercial deployment of an integrated carbon capture and storage project in North Dakota. If successful, it will help ensure wise future development of our state's abundant natural resources. If you have any questions, please contact me by telephone or by email.

Sincerely,

David Straley
Director, External Affairs

NACCO Natural Resources Land Department

2000 Schafer Street, Suite D
Bismarck, ND 58501-1204

701.258.2200

nacco.com

APPENDIX D

QUALIFICATIONS OF KEY PERSONNEL

AMANDA J. LIVERS-DOUGLAS
Assistant Director for Integrated Subsurface Projects
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5344, alivers@undeerc.org

Principal Areas of Expertise

Ms. Livers-Douglas's principal areas of interest and expertise include characterization and monitoring of the subsurface by developing innovative processing methods and designing specialized data acquisition surveys.

Education and Training

M.S., Geology, University of Kansas, 2016.
B.A., Physics, Concordia College, Moorhead, Minnesota, 2013.
Geophysics experience includes seismic reflection, seismic refraction tomography, side-scatter analysis, multichannel analysis of surface waves, backscatter analysis of surface waves, diffraction imaging, and ground-penetrating radar diffraction tomography.
Software experience includes HampsonRussell, Petrel, Vista, Omni, Kingdom, GeoTomo Geothrust and Vecon, RadExPro TomoSeis, MASW/SurfSeis, SeisUtilities, and MatLab.

Research and Professional Experience

2022–Present: Assistant Director for Integrated Subsurface Projects, EERC, UND. Leads a team of geoscientists focused on subsurface investigations of both conventional and unconventional resources, CO_2 storage, enhanced oil recovery, water disposal, and produced gas storage. Provides oversight for the development of reservoir models including the interpretation and integration of geophysical data for hydrocarbon resource assessment and geologic CO_2 storage analyses. Serves as a carbon capture and storage (CCS) project advisor for geologic site characterization, monitoring, regulatory compliance, and North Dakota underground injection control (UIC) Class VI permitting. Has served as project manager for the project development and permitting phase of several commercial carbon CCS projects. Has overseen the development of the geologic exhibits for five UIC Class VI permits submitted to the state of North Dakota and served as an expert witness at the hearings for these permits, testifying to the suitability of the storage zone for the safe and permanent storage of CO_2.

2020–2022: Principal Geoscientist, EERC, UND. Supervised an interdisciplinary team of researchers focused on understanding deep subsurface geology and provided oversight for the development of reservoir models including the interpretation and integration of geophysical data for hydrocarbon resource assessment and geologic CO_2 storage analyses.

March 2016–2019: Senior Research Geophysicist, EERC, UND. Developed geophysical models of the subsurface, performed advanced interpretation on a variety of geophysical data sets, performed petrophysical analyses of geophysical data, assisted in the preparation of technical reports, and interfaced with a diverse team of scientists and engineers to assess project uncertainties in oil and gas development and geologic CO_2 storage.

August 2013–March 2016: Exploration Division Research Assistant, Kansas Geological Survey (KGS), Lawrence, Kansas. Missouri. Developed new seismic processing methods for void detection; processed seismic data using near-surface processing methods, including refraction tomography, multichannel analysis of surface waves, backscatter analysis of surface waves, diffraction imaging, and side-scatter analysis; generated near-surface models to accompany professional reports for clients that contracted KGS services; interpreted preliminary results using generated 2D and 2.5D models, downhole data, and log data; worked on a team to produce professional site assessment reports for clients; tested in-house software, reporting encountered errors, and suggesting changes to streamline user interfaces; and designed field surveys and led field crews in seismic data collection.

May–August 2015: Geoscience Intern, Chesapeake Energy Corporate Headquarters, Oklahoma City, Oklahoma. Interpreted and correlated well logs for the Powder River Basin, Wyoming, using GeoGraphix; tied well log data to 3D seismic data, and picked formation horizons using SMT Kingdom; analyzed the relationship between seismic attribute trends and historic drilling activity, including completion and production data using SMT Kingdom and Spotfire; compiled information on the basin's geologic history, petroleum system, and current drilling activity; and presented geophysical interpretations and overview of the basin to engineering and geosciences business units.

January 2011–May 2013: Paleontology Field Investigator and Laboratory Technician, Concordia College, Moorhead, Minnesota. Developed and implemented electronic cataloging system to update 1500 bone entries; investigated Hell Creek Formation outcrops in eastern Montana for possible bone sites by walking the outcrops; recorded possible site location coordinates and transferred GPS (global positioning system) coordinates and field notes into electronic maps; and quarried, cast, and transported bones from the field, and cleaned and restored bones in the lab.

May–August 2012: Incorporated Research Institutions for Seismology Intern, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Completed 7-day training at New Mexico Tech, Socorro, New Mexico, comprising seismology short courses and field training at the Program for Array Seismic Studies of Continental Lithosphere's (PASSCAL) instrument center; surveyed seismic station locations, and deployed seismometers throughout Idaho and Oregon for an IDOR (EarthScope Idaho–Oregon) large-scale active seismic survey; processed 2D land data from the Salton Seismic Imaging Project using refraction tomography; created 2D tomography models, and interpreted subsurface structural geology; and presented results during poster session at American Geophysical Fall Meeting.

Spring 2010–Spring 2012: Student Assistant, Department of Physics, Concordia College, Moorhead, Minnesota. Served as department tutor, teaching assistant, and lab technician.

May–August 2011: North Dakota Geological Survey Student Worker, Wilson M. Laird Core and Sample Library, Grand Forks, North Dakota. Compiled reports on the 37 EarthScope Transportable Array Stations in North Dakota containing information about station locations, instrumentation, and data collection, and generated standard geologic maps for each station.

Publications

Ms. Livers-Douglas has coauthored several professional publications.

KEVIN C. CONNORS
Assistant Director for Regulatory Compliance and Energy Policy
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5236, kconnors@undeerc.org

Principal Areas of Expertise

Mr. Connors' principal areas of interest and expertise include regulatory policy, permitting, and regulatory interpretation related to the geologic storage of CO_2, enhanced oil recovery, and unconventional oil and gas development.

Education and Training

B.S., Geology, University of Montana, 2009.

Research and Professional Experience

November 2021–Present: Assistant Director for Regulatory Compliance and Energy Policy, EERC, UND. Mr. Connors works with a multidisciplinary team of scientists, engineers, and business professionals to integrate legal and regulatory policy, permitting, economics, and tax perspectives with applied research related to incremental oil recovery, unconventional oil recovery, and CO_2 capture and geologic storage. Mr. Connors also manages the Plains CO_2 Reduction (PCOR) Partnership focused on commercial deployment of carbon capture, utilization, and storage (CCUS).

July 2019–October 2021: Principal Policy & Regulatory Strategist, EERC, UND. Mr. Connors worked with a multidisciplinary team of scientists, engineers, and business professionals to integrate legal and regulatory policy, economics, and tax perspectives with applied research related to incremental oil recovery, unconventional oil recovery, and CO_2 capture and geologic storage.

November 2018–June 2019: Principal Consultant Drilling and Well Operations, Equinor Energy, Austin, Texas. Mr. Connors worked as a regulatory advisor for Equinor's Williston Basin Bakken asset. He gained experience in securing federal and state permits to drill, advising Equinor stakeholders on regulatory issues, and maintaining compliance in a multi-jurisdictional regulatory environment. Mr. Connors worked on special projects with Equinor's research and technology teams as the lead regulatory advisor in developing solutions to gas flaring and CO_2 emissions in the Bakken.

October 2010–October 2018: North Dakota Industrial Commission (NDIC) Oil and Gas Division.
October 2015–October 2018: Pipeline Program Supervisor. This position was created by the North Dakota Legislature to develop North Dakota's first Underground Gathering Pipeline Program to improve pipeline integrity. The development of the pipeline program included administrative rule making, hiring and managing office and field staff, developing a data management system (database), and meeting with industry leaders and academic researchers. Mr. Connors created guidance documents for program staff, regulatory inspectors, and the regulated community; testified before the North Dakota Legislature; and presented at public events throughout western North Dakota.

July 2011–October 2018: CCS Supervisor. This position was created by the North Dakota Legislature to

provide a timely response to the U.S. Environmental Protection Agency (EPA) rules relating to the geologic sequestration of CO_2 (Class VI). Mr. Connors successfully led North Dakota's efforts to obtain Class VI primacy for the state of North Dakota. He gained expertise in the EPA Underground Injection Control (UIC) Program and North Dakota's geologic storage of CO_2 statutes and authored and adopted North Dakota's CO_2 storage rules through the administrative rule-making process. In this position, he participated in the North Dakota Carbon Dioxide Storage Workgroup, testified before the North Dakota Administrative Rules Committee, authored publications, and presented at technical conferences on carbon capture and storage regulatory frameworks. He also has expertise in North Dakota's pore space amalgamation process for CO_2 storage and gas storage. In 2018, he developed guidelines for gas storage in North Dakota. The guidance document was intended to provide a pathway forward for permitting and storing Bakken produced gas to mitigate flaring.

October 2013–October 2015: UIC Supervisor. Mr. Connors administered the North Dakota Class II UIC Program. During his time as UIC Supervisor, he issued over 100 UIC permits, revised and updated program technical guidelines, evaluated regulatory filings, performed technical evaluations of UIC permit applications, and processed well completion reports, workover reports, and various other regulatory filings. He prepared and submitted quarterly reports to EPA as part of the UIC program primacy agreement between North Dakota and EPA. In spring 2015, Mr. Connors created a regulatory comparison table using North Dakota Statutes and regulations in comparison to the Bureau of Land Management (BLM) proposed rules on hydraulic fracturing. The regulatory comparison was key evidence in the state of North Dakota's lawsuit against the BLM.

October 2010–July 2011: Petroleum Engineer. As an oil and gas inspector, Mr. Connors conducted enforcement and compliance inspections in the field during a time of increasing oil and gas activity.

January–September 2010: Wellsite Geologist, Weatherford. Mr. Connors provided geological services for the drilling and completion of horizontal wells in the Bakken and Three Forks Formations.

Awards and Honors

2022 Governor's Award for Excellence in Public Service, for state team members who go above and beyond to serve North Dakotans and deliver on the shared purpose to Empower People, Improve Lives, and Inspire Success.

2022 Distinguished Service Award – Research & Development Program, Lignite Energy Council, for dedication and service to the Lignite Energy Council and the lignite industry in North Dakota.

Professional Activities (ask him what professional organizations he's a member of or any other professional activities he participates in)

Publications

Has authored and coauthored numerous professional publications.

JAMES A. SORENSEN
Director of Subsurface Research and Development
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5287, jsorensen@undeerc.org

Principal Areas of Expertise

Mr. Sorensen's primary areas of interest and expertise are enhanced oil recovery (EOR) in unconventional tight oil formations, CO_2 utilization and storage in geologic formations, and tight oil resource assessment and development.

Education and Training

M.Eng., Petroleum Engineering, University of North Dakota, 2020.
B.S., Geology, University of North Dakota, 1991.

Research and Professional Experience

October 2019–Present: Director of Subsurface Research and Development, EERC, UND. Mr. Sorensen is responsible for developing and managing programs and projects focused on conventional, unconventional, and enhanced oil and gas production; the geological storage of CO_2; geothermal; and other energy and environmental research.

July 2018–September 2019: Assistant Director for Subsurface Strategies, EERC, UND. Mr. Sorensen developed business opportunities, provided technical support and guidance regarding emerging areas of research, and served as a principal investigator and task manager for projects related to the sequestration of CO_2 in geologic media and the sustainable development of tight oil resources.

1999–July 2018: Principal Geologist, EERC, UND. Mr. Sorensen served as manager and co-principal investigator for programs to develop strategies for CO_2 utilization and storage. He also led research focused on enhanced oil recovery (EOR) in the Bakken.

1997–1999: Program Manager, EERC, UND. Mr. Sorensen managed projects focused on produced water management and environmental fate of natural gas-processing chemicals.

1993–1997: Geologist, EERC, UND. Mr. Sorensen conducted field-based hydrogeologic investigations focused on natural gas production sites.

1991–1993: Research Specialist, EERC, UND. Mr. Sorensen assembled and maintained comprehensive databases related to oil and gas drilling, production, and waste management.

Professional Activities

Member, Society of Petroleum Engineers

Publications

Mr. Sorensen has coauthored nearly 200 publications.

JOHN A. HAMLING
Assistant Vice President for Strategic Partnerships
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5472, jhamling@undeerc.org

Principal Areas of Expertise

Mr. Hamling has over 15 years of combined experience in unconventional oil and gas development, enhanced oil recovery (EOR), and carbon capture and storage (CCS). In his dual role as Director of Subsurface Initiatives and Assistant Vice President for CCUS (carbon capture, utilization, and storage) for the EERC Foundation, he has broadly developed and strengthened strategic business relationships and a subsurface R&D portfolio at a state, national, and global level. He has actively played a role in standing-up CCUS commercial research service capabilities within the EERC Foundation. Mr. Hamling brings scientific and engineering innovation to catalyze and implement pioneering solutions that facilitate the prudent development and use of low-carbon and fossil energy. His primary focus is on advancing technologies and concepts that enable commercial application of geologic carbon storage, unconventional oil and gas production, and improved oil recovery (IOR) in conventional and unconventional oil plays.

Mr. Hamling led efforts resulting in the development, proof-of concept, and validation of several improved monitoring techniques applicable to both dedicated and associated geologic CO_2 storage and EOR applications. His experience extends to the design, implementation, and oversight of surface, near-surface, deep subsurface, and reservoir characterization and surveillance programs.

Mr. Hamling oversees a policy and regulatory team focused on CCS, gas storage, IOR/EOR, and unconventional oil and gas development, with extensive experience conducting risk assessments and developing monitoring, mitigation, and verification (MMV)/monitoring, reporting, and verification (MRV) programs compliant with the California Air Resources Board (CARB) Low Carbon Fuel Standard (LCFS) CCS Protocol, MRV plan provisions of the U.S. Environmental Protection Agency (EPA) greenhouse gas reporting (GHGR) rule Subpart RR compliant with the Internal Revenue Service (IRS) 45Q tax credit program, EPA underground injection control (UIC) Class II and Class VI programs, state/provincial regulatory programs, and emerging carbon markets/incentive programs.

Mr. Hamling serves as a project advisor for site screening, characterization, design, qualification, and permitting efforts for multiple commercial CCS projects ranging in scale from 150,000 to 12 million tonnes of CO_2 per year. He also serves as advisor for several unconventional tight oil EOR pilots. His experience includes well-logging principals and applications, well drilling, well completions, wellbore integrity, risk assessment, logistics, well stimulation and enhanced recovery in tight oil plays, and health, safety, and environmental (HSE) programs.

Mr. Hamling has served as project manager (PM), principal investigator (PI), and task lead for several multiyear, multimillion-dollar research and demonstration projects. He has led data analytics, operations, and reservoir surveillance groups at the EERC alongside several adaptive, multidisciplinary project teams. These activities encompass both contract research as well as several strategic partnership

programs between the state of North Dakota, the U.S. Department of Energy (DOE), and private industry designed to propel the development and implementation of approaches that benefit practical energy development. Mr. Hamling is an adjunct lecturer in the Department of Petroleum Engineering at UND and a board member for the Williston Basin Society of Petroleum Engineers since 2012. Prior to joining the EERC, Mr. Hamling worked as a Reservoir Evaluation Engineer with Schlumberger.

Education and Training

B.S., Mechanical Engineering, University of North Dakota, 2007.
Associate of Science, Associate of Arts, Williston State College, 2004.
Certified Engineer in Training (EIT)

Research and Professional Experience

May 2021–Present: Director of Subsurface Initiatives, and Assistant Vice President for CCUS, EERC Foundation, EERC, UND. In his dual role as Director of Subsurface Initiatives and Assistant Vice President for CCUS (carbon capture, utilization, and storage) for the EERC Foundation, he has broadly developed and strengthened strategic business relationships and a subsurface R&D portfolio at a state, national, and global level. He has actively played a role in standing-up CCUS commercial research service capabilities within the EERC Foundation. Mr. Hamling brings scientific and engineering innovation to catalyze and implement pioneering solutions that facilitate the prudent development and use of low-carbon and fossil energy. His primary focus is on advancing technologies and concepts that enable commercial application of geologic carbon storage, unconventional oil and gas production and IOR in conventional and unconventional oil plays.

2018–April 2021: Assistant Director of Integrated Projects, EERC, UND. In this role, Mr. Hamling advanced innovation and technologies to enable commercial application of geologic carbon storage, unconventional oil and gas production, and IOR in both conventional and unconventional oil plays.

2017–Present: Adjunct Lecturer, Department of Petroleum Engineering, UND.

2012–2018: Principal Engineer, Oilfield Operations Group Lead, EERC, UND. Mr. Hamling served as PM, PI, and task lead for several multiyear, multimillion-dollar projects, where he led a multidisciplinary team of scientists and engineers working to develop and implement MVA concepts for large-scale (>1 million tons per year) CO_2 storage and EOR operations. He also worked with a multidisciplinary team in the development, design, and implementation of new approaches that benefit the economical exploration, development, and production of oil and gas.

2011–2012: Research Manager, EERC, UND. Mr. Hamling's responsibilities included managing characterization and monitoring research activities and operations for large-scale (>1 million tons per year) combined EOR and CO_2 storage projects for the Plains CO_2 Reduction (PCOR) Partnership. He also led various research activities related to oil and gas production, infrastructure, and development from unconventional reservoirs.

2009–2011: Research Engineer, EERC, UND. Mr. Hamling's focus was on the design and implementation of new approaches that benefit the exploration, development, and production of oil and gas and with the PCOR Partnership, where he evaluated the potential for CO_2 storage in geologic formations. Specific responsibilities included field operations design, deployment, and interpretation relating to oilfield technologies applicable to the CCS industry; laboratory functions relating to the Applied Geology Laboratory (AGL); data analysis; regulatory compliance; and communication of operations between

service providers, management teams, industry partners, and governmental organizations. Additional responsibilities included investigation and/or demonstration of techniques and/or technologies that can enhance oil and gas production or economically benefit the oil and gas industry while reducing the environmental footprint of drilling and production operations.

2007–2009: Reservoir Evaluation Engineer; HSE Representative; and Loss Prevention Team Leader, Reservoir Evaluation segment, Schlumberger Limited. Mr. Hamling was responsible for providing tailored geophysical solutions for specific and unique oilfield applications, executing basic and advanced reservoir evaluations utilizing real-time wellbore measurement technologies, reservoir pressure and fluid sampling, and interpretation of reservoir measurement data. In this role, Mr. Hamling designed and oversaw all aspects of openhole and cased-hole logging operations for over 300 wells in both conventional and unconventional oil and gas plays. He also served as an HSE officer, loss prevention team lead, and explosives and radiation safety officer for wellsite activities.

2004–2007: Student Research Scientist/Engineer, EERC, UND. Mr. Hamling was responsible for conducting research related to the development of new methods to join high-temperature, creep-resistant alloys and advanced processing and manufacture techniques for silicon carbide ceramic composites; materials testing in accordance with ASME (American Society of Mechanical Engineers), ASTM International, and ISO (International Organization for Standardization) standards; analyzing scanning electron microscopy micrographs; designing and fabricating composite micrometeorite shielding; and literature and patent review.

Professional Activities

Society of Petroleum Engineers International Williston Basin Section – have continuously served as a section officer and board member since 2012. Positions include Acting Chairperson, Vice-Chairperson, and Communications Chairperson.

Served as PCOR Partnership representative on the writing committee for two U.S. Department of Energy Regional Carbon Sequestration Partnership (RCSP) Program BPMs entitled *Best Practices for Monitoring, Verification, and Accounting of CO_2 Stored in Deep Geologic Formations – Version 3* and *Best Practices for Operating Carbon Storage Projects*.

Publications

Mr. Hamling has authored and coauthored numerous technical publications.

NESET

RESUME: ***KATHLEEN NESET*** Updated: November 28, 2022

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PROFESSIONAL: ND Petroleum Council Board of Directors, Executive Committee
North Dakota Petroleum Council: Past Chair
ND Clean Sustainable Energy Authority
ND Early Childhood Transition Committee
UND College of Engineering and Mines Executive Board
UND Petroleum Engineering Industry Advisory Committee
Theodore Roosevelt Medora Foundation Board of Directors
Diocese of Bismarck Catholic Foundation Board of Directors
API Williston, Dickinson, Minot ND Chapters: Member
AAPG: Member
North Dakota Geological Society
Federal Reserve Bank of Minneapolis: Past Director
North Dakota State Board of Higher Education: Past Chair
ND 2020 & Beyond: Co-chair

EDUCATION:

December 2021	H2S Safety Training
September 2018	Shell Energy Executive Program, Roberts, Louisiana
April 2011	Hess Home Safe
April 2009	Core Workshop, Regina, Saskatchewan
March 2009	H_2S Respirator Fit Test
April 2008	Complex Well Workshop, Minot, North Dakota
May 2002	Horizontal Technology for Geologists, Short Course, Mauer Technology Inc. Bismarck, ND.
May 2001	Nisku Core Workshop, Regina, Saskatchewan
May 1984	Well Control School, Prentice Training, Lafayette, LA.
June 1978	B.A. Brown University, Providence, Rhode Island. Geology major with emphasis in mathematics.
June 1974	Warren Hills Regional High School, Washington, NewJersey.

AWARDS & CERTFICATES:

2022: Woman Business Enterprise National Council certification
2022: Woman Owned Small Business
2022: Woman Business Enterprise
2014: Williston API Individual Outstanding Achievement winner
2014: Top 25 Leading Women in Business
2014: Ambassador Award - Williston Regional Economic Development Corporation
2015: Williston API Lifetime Achievement Award
2015: North Dakota Petroleum Council Hall of Fame
2015: Leading Ladies Panelist
2017 University of Mary Virtuous Leadership Award
2018 Inspired Woman Award

GENERAL EXPERIENCE:

March 1980 to present:
President, Neset Consulting Service, manage wellsite geology, engineering, and mudlogging consulting business. From 1980 through 2006 Roy and Kathleen started, managed, and lead Neset Consulting Service as we provided geological and engineering services to the oil industry, primarily in the Northern Rockies. From 2006 to present Kathleen has served as president of the company with a new branding to NESET in 2018. This rebranding represented the continual reinventing of the company to meet the diverse needs of the ever changing oil and gas industry. Recently the focus has built out and embraced carbon capture and management for the industry. NESET has been involved both geologically and with overall operational management of multiple carbon sequestration projects in ND. Work has also included the development of wind technician training for the wind industry, and NESET has broadened engineering providing all engineering, surveying, wellsite supervision, and well design and management.

March 1980 to Sept 2006:
Wellsite geologist, Tioga, ND: through wellsite work in the Rocky Mountains, I have acquired techniques for the complete evaluation of both wildcat and development wells. My experience in horizontal drilling has kept me current in the newest trends of oil and gas exploration, including the targeting of remote bottomhole locations in highly deviated wellbores and multi-laterals. Recent work has given me horizontal experience in the Ordovician Montoya formation of the Permian Basin, West Texas.

August 1990 to January 1992:
Temporary Business Manager, Tioga Public Schools, Tioga, ND.

November 1985 to May 1986:
Science Teacher, Tioga High School, Tioga, ND.

February 1979 to March 1980:
Hydrocarbon well logger, Core Laboratories, Casper, Wyoming: provided me with invaluable wellsite knowledge and experience. Through logging I have seen firsthand the geology of East Texas, the Powder River Basin, Green River Basin, and the Williston Basin. I have also gained wellsite experience in east Texas, and seismic experience in Michigan.

Randy Neset
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Current Residence: Tioga ND

Neset Consulting Employment History

Vice President of Engineering

- ◊ General drilling contractor for large CCUS project western North Dakota
- ◊ General drilling contractor for over 12 saltwater disposal wells
- ◊ Design drilling and completion programs for horizontal Bakken and Three Forks and SWD wells
- ◊ Manage 150 field personnel including drilling, completion, and production supervisors, safety supervisors, midstream operators, lease operators, OGI technicians, and well techs
- ◊ Successfully work with NDIC as lead contractor to plug and abandon wells with CARES Act Funds
- ◊ Establish strategic partnerships with industry service companies to provide first in class services to clients
- ◊ Develop vendor management and accounts payable procedures for NDIC P&A program, CCUS programs, and EERC wells
- ◊ Train mudloggers and lease operators on oil and gas operations
- ◊ Assist in managing over 300 mudloggers operating on over a peak of 112 drilling rigs

Experience:

SHD Oil & Gas, LLC – Tioga ND **Dates Employed: 2010 – 2021**
Chief Operating Officer

- ◊ Assist raising over $350 million around project
- ◊ HBP over 37,000 acres
- ◊ Increase production from 0 – 10,000 bopd
- ◊ Direct all field operations including drilling, completions, and production
- ◊ Solicit bids and hire contractors for interim wellsite reclamation
- ◊ Work with surveyors for scouting, staking, and permitting in accordance with BIA, BLM, TERO, and State of North Dakota regulations
- ◊ Solicit bids and hire contractors for wellsite construction
- ◊ Field development design utilizing multi-well pads
- ◊ Develop drilling plan - hire all contractors for drilling operations
- ◊ Reservoir engineering - volumetrics to calculate OOIP
- ◊ Manage daily production and operations
- ◊ Provide technical support to lease operators
- ◊ Design production facilities
- ◊ Design rod and tubing strings, downhole pumps, pumping units
- ◊ Supervise workover rig - SRL installation and workovers

RC Disposal, LLC – Tioga ND **Dates Employed: 2011 – 2014**
President
Responsibilities included raising $7.5 million to drill and complete 2 x SWD wells, permitting salt water disposal well through NDIC, generating AFE salt water disposal well, designing wellbore and surface

facilities, hiring service contractors to perform work, overseeing drilling and completion of well, and managing day to day operations. The company was successfully sold for $20 million.

Hess Corporation – Tioga ND **Dates Employed: 2009 - 2010 Artificial Lift Tech**
Responsibilities included providing technical support to Lease Operators, analyzing dynamometer cards for downhole pump performance, designing rod and tubing strings, downhole pumps, pumping units, writing workover procedures and cost estimates, designing treatment programs for scale, corrosion, and paraffin and training – Roustabout, Lease Operator, Workover Rig Manager.

Helmerich and Payne – Dickinson ND **Dates Employed: 2008**
Roughneck
Responsibilities included serving as a floorhand, performing rig up, rig down operations, making up BHA and drill pipe, teaching new rig hands the floorhand responsibilities and general rig maintenance.

Eagle Well Service – Kenmare ND **Dates Employed: 2007**
Righand
Responsibilities included serving as a floorhand, operating tubing and rod tongs, operating rig while swabbing during well completions and teaching new rig hands the floorhand responsibilities

Montana Air National Guard – Great Falls MT **Dates Employed: 2002 - 2010**
Intelligence Analyst
Responsibilities included providing timely threat analysis to F-16 pilots, providing current intelligence to Wing Commander, keeping Intelligence library updated with newly released material, supervising airmen appointed to me, ensuring on the job training is adequate for younger airmen and completing Pacific AEF tour in South Korea and Operation Iraqi Freedom Tour – 6 months at Balad AB, Iraq. Received an Air Force Achievement Award.

Larry's Service – Tioga ND **Dates Employed: 1999 - 2002**
Mechanic Assistant
Responsibilities included installation of new tires on vehicles and ensure customer's vehicle is safe to drive, changing oil and service customer's vehicle to shop standards, serving as an associate with customers to ensure their vehicle is serviced the way they would like, helping lead mechanic install engines, transmissions, axles, transfer cases and service all of these items and test driving vehicles to ensure mechanical problems are fixed.

Neset Farms – Tioga ND **Dates Employed: 1999 - 2002**
Heavy equipment operator/laborer
Responsibilities included operation of farm machinery, maintenance of Neset Farms grain elevator, calibration of seeder, sprayer, and combine for optimal efficiency and maintaining records of labor time, fuel used, hourly use of equipment, items purchased and regular farm supplies

Skills & Education:
Graduated high school from Tioga ND in 2002
Montana Tech – Bachelors of Science in Petroleum Engineering, graduated in May 2009

- ◊ Microsoft Word
- ◊ Microsoft Excel
- ◊ Microsoft Powerpoint
- ◊ WellView
- ◊ WellEZ
- ◊ Adobe
- ◊ Well Control Certified
- ◊ WellPro
- ◊ H_2S Certified
- ◊ 10 HR OSHA

Jessica K. Bell
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• **b**elljessicak@gmail.com

OBJECTIVE

To continue my endeavor to positively impact individuals and promote the energy industry by utilizing my experience in environmental and tax policy, business development and government relations.

EXPERIENCE

Rainbow Energy Center; August 2022-Current
Director, Government & Public Affairs

- Execute project development opportunities
- Evaluate best practices for carbon capture utilization and storage technologies
- Coordinate research efforts with the EERC
- Enhance environmental, social and governance practices
- Monitor and evaluate Federal and State regulations as they pertain to independent power producers
- Interact with regional transmission operators to ensure power deliverability

NACCO Natural Resources; May 2004-Current
Environmental Manager of Northern Operations (2020-2022)

- Oversee and manage all environmental matters for northern operations
- Evaluate best practices for carbon management, including carbon capture utilization and storage technologies, soil carbon storage and other opportunities
- Evaluate and improve environmental, social and governance compliance
- Monitor and evaluate Federal environmental regulations impacting operations and articulate the position of NACCO Natural Resources for Federal Register Notice filings

Coyote Creek Mining Company
Environmental Manager (2017-2020)

- Primarily responsible for all environmental duties at the mine site including securing all permits for operation at local, state and federal level, air quality, wildlife management, cultural resources management, waste management and short and long-term budgeting and department management
- Active participant in the Lignite Energy Council trade organization
- Completed life of mine Individual Permit from the Department of the Army Corps of Engineers
- Initiated application to mine Federal coal with the Department of the Interior

The Coteau Properties Company Freedom Mine
Environmental Specialist (2007-2017); Tour Guide (2006-2007); Environmental Assistant (2004-2005)

- Manage over 15,000 acres of mined and reclaimed farm land alongside local producers
- Repeatedly proved mined and reclaimed farm land is more successful than before mining and released thousands of acres of productive land from company liability and bonds
- Write and update all environmental sections of mining permits
- Supervisory experience of both employees and contractors
- Initiated environmental baseline studies for first new coal mine in 30 years in ND

North Dakota State Senate; Nov 2012-Nov 2022
District 33 Senator & Citizen Legislator

Sixty-third Legislative Assembly

- Member of Industry, Business & Labor and Natural Resources standing committees and Vice- Chair of the Advisory Commission on Intergovernmental Relations interim committee, the former of which was statutorily eliminated during the subsequent legislative session to reduce government bureaucracy; Member of the Taxation interim committee
- Unanimously elected most outstanding freshman senator

Sixty-fourth Legislative Assembly

- Vice-Chair of Energy & Natural Resources and member of Finance & Taxation standing committees, Chair of the Taxation interim committee to study enhanced oil recovery and carbon dioxide capture technologies and related tax incentives and regulatory policies; and member of the Political Subdivision Taxation and Water Topics Overview interim committees
- Elected by peers to Legislative Management and selected to serve on the State Council for Interstate Adult Offender Supervision and the Commission on Legal Counsel for Indigents

Sixty-fifth Legislative Assembly

- Chair of Energy & Natural Resources and member of Finance & Taxation standing committees, Chair of the Taxation interim committee to study state business tax incentives and property taxes, member of Energy Development and Transmission interim committee and member of State Council for Interstate Adult Offender Supervision

Sixty-sixth Legislative Assembly

- Chair of Energy & Natural Resources, member of Finance & Taxation standing committees, Vice-Chair of the special committee on Ethics and member of the Government Finance, Human Services, Legacy Fund Earnings and Taxation interim committees

Sixty-seventh Legislative Assembly

- Chair of Finance & Taxation and member of Energy & Natural Resources standing committees, Chair of the Energy Development and Transmission interim committee and member of the Legacy Fund Earnings and Tribal and State Relations interim committees
- Elected by peers to Legislative Management

Legislative Accomplishments

- Prime sponsor of extensive property tax and industrial tax reform, creation of the Department of Environmental Quality, pore space use and migration reform and numerous energy-related issues
- Creation of the Pipeline Restoration and Oversight Program for landowners
- Main resource for legislative leaders on energy, ESG, taxation and regulatory issues
- Advocate for the elimination of inefficient government and incorporating business-minded policies to improve government agencies and proponent of investments in statewide infrastructure

EDUCATION

North Dakota State University; Sept 2002-May 2006

Bachelor of Science Degree

- Natural Resources Management, Major
  - Social Sciences Emphasis
- Economics, Major

JOHN A. BRUNNER
Research Engineer
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
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Principal Areas of Expertise

Mr. Brunner's principal areas of interest and expertise include design and modeling of experimental equipment, gasification and combustion technologies, energy storage systems, and renewable energy technologies.

Education and Training

B.S., Mechanical Engineering, University of North Dakota, 2019.
Software experience includes Microsoft Office Suite, PTC Creo, Visio, Autodesk, MATLAB, GT Suite, and Solidworks.
Fabrication experience includes pipe/tube bending and cutting and MIG and SMAW welding.

Research and Professional Experience

May 2019–Present: Research Engineer, EERC, UND. Mr. Brunner contributes to the design, modeling, and fabrication of experimental equipment, including overseeing and operating the equipment; assists in preparation of proposals; interprets data; writes reports and papers; and presents results to clients and papers at national and international conferences.

April 2018–April 2019: Research Engineering Assistant, EERC, UND. Mr. Brunner's responsibilities included the following:

- Worked on the design and modeling of flue gas exhaust.
- Assisted in modeling of a carbon dioxide capture system.
- Modeled a portable baghouse.
- Led a project to integrate virtual reality into the engineering design process.

February 2016–April 2018: Facilities and Safety Assistant, EERC, UND. Mr. Brunner's responsibilities included the following:

- Conducted scheduled safety inspections.
- Assisted in the hazard communication program.
- Calibrated and maintained safety equipment.

Summers 2015–2017: Laboratory Intern, RMB Environmental Laboratories, Detroit Lakes, Minnesota. Mr. Brunner's responsibilities included the following:

- Conducted nitrate and nitrite testing.
- Assisted in total phosphorus, ortho-phosphorus, biological oxygen demand, chemical biological oxygen demand, bacteria, and solids testing.

Publications

Mr. Brunner has coauthored several publications.

DR. CHANTSALMAA DALKHAA
Principal Reservoir Engineer, Reservoir Engineering Team
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
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701.777.5448, dalkhaa@undeerc.org

Principal Areas of Expertise

Dr. Dalkhaa's principal areas of interest and expertise include numerical modeling and simulation of various enhanced oil recovery (EOR) techniques, including solvent and thermal methods and cold heavy oil production with sand (CHOPS); CO_2 sequestration and monitoring; and production evaluation and estimation of ultimate recovery of unconventional shale oil plays.

Education and Training

Ph.D., Petroleum and Natural Gas Engineering, Middle East Technical University (METU), Ankara, Turkey, 2010.
M.S., Petroleum and Natural Gas Engineering, METU, Ankara, Turkey, 2005.
B.S., Petroleum and Natural Gas Engineering, METU, Ankara, Turkey, 2003.
Proficient in the use of Petrel (geologic modeling), Eclipse (fluid flow reservoir simulation), CMG IMEX/STARS/GEM/CMOST, TOUGH2/TOUGHREACT, ArcGIS/Arcmap, and IHS Harmony/DeclinePLUS/RTA/Petra.

Research and Professional Experience

February 2020–Present: Principal Reservoir Engineer, Reservoir Engineering Team, EERC, UND. Dr. Dalkhaa coleads the Reservoir Engineering Team, supervises reservoir engineers and geoscientists, manages and oversees projects, contributes to research proposal writing and preparation, and conducts technical and research work.

June 2019–January 2020: Senior Reservoir Engineer, Reservoir Engineering Team, EERC, UND. Dr. Dalkhaa supervised junior reservoir engineers and student research assistants and worked with reservoir engineers, geologists, and geophysicists to develop and calibrate geologic models of the subsurface and run dynamic simulations to evaluate CO_2 EOR performance of oil fields and the long-term fate of CO_2 sequestration into saline aquifers, evaluate production performance of unconventional oil and gas reservoirs, and assess refracturing potential in the Bakken petroleum system.

2016–May 2019: Reservoir Engineer, Reservoir Modeling and Simulation, EERC, UND. Dr. Dalkhaa worked with teams of reservoir engineers, geologists, and geophysicists to develop and calibrate geologic models of the subsurface and run dynamic simulations to evaluate CO_2 EOR performance of oil fields and the long-term fate of CO_2 sequestration into saline aquifers, estimate ultimate oil recovery, and evaluate production performance of unconventional oil reservoirs.
2014–2015: Postdoctoral Fellow, Department of Chemical and Petroleum Engineering, University of Calgary, Calgary, Alberta, Canada. Dr. Dalkhaa's activities included the following:

- Construction of a geologic model of heavy Canadian oil fields using Petrel.

- Simulation of a wormhole formation and growth in CHOPS reservoir and history matching of reservoir fluid and sand productions.
- Assessment of reservoir performance of thermal, solvent, and hybrid EOR methods using CMG STARS.

2011–2014: Postdoctoral Fellow, Department of Geoscience, University of Calgary, Calgary, Alberta, Canada. Dr. Dalkhaa's activities included the following:

- Stimulation of microbial activities in a CHOPS reservoir in the Lloydminster area, Canada, to enhance oil recovery for a project funded by Natural Sciences and Engineering Research Council of Canada and Husky Oil Operation Ltd.
- Reactive transport simulation of CO_2 injection into a reservoir and CO_2 leakage to shallower formations for the Quest Project, funded by Shell Canada.
- Application of stable isotopic techniques in monitoring of injected CO_2 for the Quest Project and Swan Hills and PennWest CO_2 pilot projects.
- Simulation of CO_2 injection into a H_2S-containing aquifer located in central Alberta for a project funded by Carbon Management Canada.
- Oilfield fluid sampling and analysis at various fields (Pembina Cardium CO_2 EOR pilot, Swan Hills CO_2 EOR fields in the Western Canadian Sedimentary Basin).
- Laboratory work on CO_2 reactivity and microbial EOR in CHOPS reservoirs.

2006–2011: Research and Teaching Assistant, Department of Petroleum & Natural Gas Engineering, METU, Ankara, Turkey. Dr. Dalkhaa's activities included the following:

- Reservoir simulation of immiscible CO_2 and water alternating gas injection into a heavy oil field in Europe in southeastern Turkey using Eclipse/Petrel (2007–2009).
- Mentorship and guidance of senior year students for graduation projects and coordination of courses (2007–2011).
- Evaluation of coalbed methane production capacity from the Soma coal bed in Turkey (2011).

Professional Activities

Member, Association of Professional Engineers and Geoscientists of Alberta – Engineer in Training (2011–present)
Member, Society of Petroleum Engineers (2003–present)
Member, European Association of Geoscientists and Engineers (2010)
Member, The Geochemical Society (2012)
Technical Reviewer, *Journal of CO_2 Utilization* (since 2019), *International Journal of Greenhouse Gas Control* (since 2017), and *Greenhouse Gases: Science and Technology* (since 2017)
Postdoctoral Representative, Faculty of Science, University of Calgary (2012–2013)
General volunteer, MentorUp Calgary (2014)
General volunteer, APEGA (2014)
Member, EERC Social Cause Committee (since 2016)

Publications

Dr. Dalkhaa has coauthored several professional publications.

JOHN P. KAY
Principal Engineer, Emissions and Carbon Capture
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.4580, jkay@undeerc.org

Principal Areas of Expertise

Mr. Kay's principal areas of interest and expertise include applications of solvents for removing CO_2 from gas streams to advance technology and look toward transformational concepts and techno-economic assessments. He has 12 years of experience in field testing site management and sampling techniques for hazardous air pollutants and mercury control in combustion systems along with10 years of experience utilizing scanning electron microscopy (SEM), x-ray diffraction (XRD), and x-ray fluorescence (XRF) techniques to analyze coal, fly ash, biomass, ceramics, and high-temperature specialty alloys. He is also interested in computer modeling systems, and high-temperature testing systems.

Education and Training

B.S., Geological Engineering, University of North Dakota, 1994.
Associate Degree, Engineering Studies, Minot State University, 1989.

Research and Professional Experience

2011–Present: Principal Engineer, Emissions and Carbon Capture, EERC, UND. Mr. Kay's responsibilities include management of CO_2 separation research related to bench-, pilot-, and demonstration-scale equipment for the advancement of the technology. This also includes the development of cleanup systems to remove SO_x, NO_x, particulate, and trace elements to render flue gas clean enough for separation.

2005–2011: Research Manager, EERC, UND. Mr. Kay's responsibilities included the management and supervision of research involving the design and operation of bench-, pilot-, and demonstration-scale equipment for development of clean coal technologies. The work also involved the testing and development of fuel conversion (combustion and gasification) and gas cleanup systems for the removal of sulfur, nitrogen, particulate, and trace elements.

1994–2005: Research Specialist, EERC, UND. Mr. Kay's responsibilities included conducting SEM, XRD, and XRF analysis and maintenance; creating innovative techniques for the analysis and interpretation of coal, fly ash, biomass, ceramics, alloys, high-temperature specialty alloys, and biological tissue; managing the day-to-day operations of the Natural Materials Analytical Research Laboratory; supervising student workers; developing and performing infrared analysis methods in high-temperature environments; and performing field work related to mercury control in combustion systems.

1993–1994: Research Technician, Agvise Laboratories, Northwood, North Dakota. Mr. Kay's responsibilities included receiving and processing frozen soil samples for laboratory testing of chemical penetration, maintaining equipment and inventory, and training others in processing techniques utilizing proper laboratory procedures.

1991–1993: Teaching Assistant, Department of Geology and Geological Engineering, UND. Mr. Kay taught Introduction to Geology Recitation, Introduction to Geology Laboratory, and Structural Geology. Responsibilities included preparation and grading of assignments and administering and grading class examinations.

1990–1992: Research Assistant, Natural Materials Analytical Laboratory, EERC, UND. Mr. Kay's responsibilities included operating an x-ray diffractometer and interpreting and manipulating XRD data, performing software manipulation for analysis of XRD data, performing maintenance and repair of the XRD machine and sample carbon coating machine, preparing samples for XRD and SEM analysis, and performing point count analysis on the SEM.

Professional Activities
Member, ASM International
Member, American Ceramic Society
Member, Microscopy Society of America

Publications
Mr. Kay has authored or coauthored numerous publications.

RYAN J. KLAPPERICH
Principal Geoscientist
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
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701.777.5430, rklapperich@undeerc.org

Principal Areas of Expertise

Mr. Klapperich's principal areas of interest and expertise focus on CO_2 enhanced oil recovery (EOR) and storage, including geologic site characterization, monitoring program assessments, design and implementation of near-surface monitoring programs, and interpretation of monitoring data. Other areas of interest include hydrogeology, geographic information systems (GIS), CO_2 sequestration, and related environmental issues.

Education and Training

M.S., Geology, University of North Dakota, 2008.
Graduate Certificate, Geographic Information Science, 2007.
B.S., Geology, University of North Dakota, 2005.
B.A., Honors Program, University of North Dakota, 2005.

Research and Professional Experience

2020–Present: Principal Geoscientist, EERC, UND.

2009–2019: Principal Hydrogeologist, EERC, UND. Mr. Klapperich works with the Oil and Gas Group and the Plains CO_2 Reduction (PCOR) Partnership at the EERC, where he is actively involved in site characterization and CO_2-monitoring activities including the following:

- Serves as Co-PI and task lead for active reservoir management (ARM) operations on the U.S. Department of Energy (DOE)-sponsored brine extraction and storage test (BEST) project. The BEST project will demonstrate the use of ARM techniques to improve reservoir storage potential in saline formations. In this role, Mr. Klapperich directs field activities and data analysis to assess the performance of various ARM strategies at the BEST project site.
- Serves as task lead for site characterization on the DOE-sponsored CarbonSAFE-North Dakota integrated carbon storage complex feasibility study to develop a technical and economic case for commercial CO_2 storage from coal-fired power plants in North Dakota. In this role, Mr. Klapperich leads the effort to drill and characterize two new wells in western North Dakota to characterize the CO_2 storage potential of the Broom Creek Formation.
- Serves as task lead for permitting on the integrated carbon capture and storage for North Dakota ethanol study to develop a pathway for implementation of commercial CO_2 storage for North Dakota ethanol facilities.
- Serves as task lead on the recently awarded DOE-sponsored CO_2 EOR in conventional fields using rich gas project.
- Served as co-principal investigator (PI) on a project principally funded by the IEA Greenhouse Gas R&D Programme (IEAGHG) focused on understanding the use of ARM schemes to enhance CO_2 storage and reduce monitoring, verification, and accounting (MVA) costs.

- Served as task lead for the PCOR Partnership's Water Working Group, a working group comprising members of DOE's Regional Carbon Sequestration Partnership (RCSP) Program focused on developing an understanding and solutions for issues at the nexus of carbon capture and storage (CCS) and water.
- Conducts geologic and hydrogeologic evaluations, processes data, communicates results through reports and presentations, conducts client meetings, manages project budgets and time lines, and participates in professional conferences.

2007–2009: Laboratory Technician, North Dakota Geological Survey Core and Sample Library, Grand Forks, North Dakota. Mr. Klapperich's responsibilities included staging and taking digital photographs of core sample inventory; processing and manipulating digital photographs; updating, cataloging, and reboxing core and sample inventory; cutting unprocessed cores into slabs; processing and cataloging new inventory; assisting clients with retrieving and handling samples; and operating a forklift.

2006–2007: Research Assistant, Geology and Geological Engineering, UND. Mr. Klapperich's responsibilities included refining new analytical laboratory procedures, performing analytical procedures in the Environmental Analytical Research Laboratory, and analyzing collected data; performing literature reviews and preparing materials for grant submissions, progress reports, and presentations/publications; maintaining proper quality control and quality assurance while working as a team member with other students and lab personnel; and provided tours of exhibits in Leonard Hall.

2005–2006: Teaching Assistant, Department of Geology and Geological Engineering, UND. Mr. Klapperich's responsibilities included preparing brief introductory lectures, administering weekly quizzes and makeup sessions, preparing course materials such as hand specimens or handouts, maintaining course grades, and assisting with student inquiries for a physical geology laboratory course as well as providing tours of exhibits in Leonard Hall.

Professional Activities
Member, Society of Petroleum Engineers, 2009–present
Member, American Geophysical Union, 2007–2009

Publications
Mr. Klapperich has authored or coauthored numerous professional publications.

JOHN S. OLEKSIK
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Professional Areas of Expertise
Mr. Oleksik's principal areas of interest and expertise include energy and chemical conversion, pre- and postcombustion carbon capture and utilization, emission control and impurities removal, upstream petroleum production facilities, and economic assessment.

Education and Training
B.S., Petroleum Engineering, University of North Dakota, 2016.
B.A., Economics, University of North Dakota, 2016.

Research and Professional Experience
May 2021–Present: Senior Engineer, Team Lead, EERC, UND.

April 2019–April 2021: Research Engineer, Advanced Energy Systems, EERC, UND. Mr. Oleksik contributed to the design, modeling, and fabrication of experimental equipment; oversaw and operated equipment; interpreted data; helped to prepare proposals, reports, and papers; and presented project results to clients and at national and international conferences.

October 2018–April 2019: Research Engineer (temporary), EERC, UND. Mr. Oleksik served as a floor engineer for the operation of a pilot-scale coal gasification system. Specific responsibilities included assisting in the planning and execution of equipment and system assembly; preparing, moving, and assembling pilot-scale components for testing; and in-field troubleshooting of malfunctioning system components.

May 2017–Present: Partner, JOLS Contractors LLP, Williston, North Dakota. Mr. Oleksik partnered with other general contractors in a residential roofing, remodeling, and repair business. Specific responsibilities included planning and designing projects to meet customer needs, coordinating with other contractors to schedule work and complete projects on time and on budget, bidding, expensing, and billing.

January–April 2017: Associate Field Technology Specialist, Halliburton, Williston, North Dakota. Mr. Oleksik performed testing on water, sand, and fracture fluid samples to ensure quality of work maintained and tracked pressure, chemical concentrations, sand concentrations, and fluid downhole rate to assist fracture crew in delivering fracture to customer design specifications

August 2015–May 2016: Managing Director of Marketing, Dakota Venture Group. Mr. Oleksik worked toward new recruiting strategy for developing talent within Dakota Venture Group; maintained

communication between investors, alumni, advisory board, and group members; released updates, newsletters, quarterly updates, and promotional material; and executed four due diligence reports, one of which serving as team lead.

Summer 2015: Drilling Engineer Intern, Marathon Oil Corporation, Williston, North Dakota.

Summer 2014: Floorhand, Nabors Drilling USA, Williston, North Dakota.

Summers 2012 and 2013: Warehouse Supervisor, Total Service Supply, Williston, North Dakota.

Professional Activities

Member, Society of Petroleum Engineers

Publications

Mr. Oleksik has coauthored several publications.

CAITLIN M. OLSEN
Senior Regulatory and Permitting Specialist
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Principal Areas of Expertise

Ms. Olsen's principal areas of interest and expertise include regulatory compliance; geologic CO_2 capture, utilization, and storage (CCUS); power generation; emissions reduction; and renewable energy systems. In addition, Ms. Olsen has experience in the areas of project management, data analysis, staff supervision and development, and safety audits.

Education and Training

B.S., Geology with a Hydrogeology minor, University of Wisconsin – River Falls, 2013.

Research and Professional Experience

February 2022–Present: Senior Regulatory and Permitting Specialist, EERC, UND. Ms. Olsen works with a multidisciplinary team of scientists, engineers, and business professionals to integrate permitting, regulatory, legal, policy, economics, and tax perspectives with technical information and applied research related to incremental oil recovery, unconventional oil recovery, geologic CCUS, power generation, emissions reduction, and renewable energy systems.

August 2021–January 2022: Assistant Compliance Manager, Mayo Clinic, Rochester, Minnesota. Ms. Olsen's activities included the following:

- Created and managed the compliance assurance program for the Facilities Management Division at the Mayo Clinic.
- Served as the project manager for developing and implementing a lockout tagout program for southeast Minnesota health systems hospitals and clinics.
- Developed and implemented confined-space protocols for southeast Minnesota hospitals and clinics.
- Maintained currency in assigned compliance areas including the Joint Commission, the Occupational Safety and Health Administration (OSHA), and the U.S. Environmental Protection Agency (EPA).

June 2018–July 2021: Production and Measurement Supervisor, North Dakota Industrial Commission (NDIC) Oil and Gas Division, Bismarck, North Dakota. Ms. Olsen's activities included the following:

- Supervised the work of the production, auditing, and measurement department, which includes a team of field inspectors, production assistants, and temporary office workers. Coordinated and reviewed production reporting processes, measurement processes, and measurement reporting processes that support the regulatory functions of NDIC. Led the Production and Measurement team on various production-tracking and metering projects, including working with web developers to build new a reporting database.
- Managed oil-conditioning and gas capture compliance projects within the state of North Dakota. Analyzed statistical data to predict and summarize future gas capture changes.

- Conducted and coordinated response to industry and public inquiries related to production reporting and oil and gas measurement-related field activities, provide responses in a timely manner. Maintained relationships with gas midstream providers and provided strong communication lines with executive personnel.
- Reviewed surface commingling applications, tracked and input meter information, reviewed proving reports, and tracked natural gas liquid (NGL) units.
- Conducted yearly appraisals, organized workflow, monitored employee productivity, hired and trained new employees, and performed other supervisorial duties.
- Developed, researched, and delivered orders of the Commission including gas capture and oil conditioning policies, resulting in statewide changes to oil and gas production protocol.

November 2013–June 2018: Petroleum Engineer–Field Inspector, NDIC Oil and Gas Division, Williston, North Dakota. Ms. Olsen's activities included the following:

- Conducted physical compliance inspections of drilling exploration and oil production sites, which included permitted locations, drill rigs, production and injection wells, and associated facilities.
- Ensured permitting compliance for drilling rigs. Compiled information on geologic zones penetrated, drillstem tests run, cores cut, and directional surveys.
- Inspected well completions, recompletions, workovers, plugged wellsites, and pipelines to monitor and evaluate progress of reclamation. Approved openhole-plugging procedures and witnessed plugging of wells to ensure proper isolation of oil and water reservoirs.
- Oversaw remediation of spills in wetlands, sloughs, grassland, and cropland and monitored requirements of environmental and reclamation concerns. Investigated and responded to public complaints and operator inquiries.
- Ensured compliance guidelines were met by working with EPA, the Bureau of Land Management, and the Forest Service.
- Generated a diverse range of presentations including oil conditioning policies, gas capture recommendations, electromagnetic (EM) and electrical resistivity tomography (ERT) surveying, microseismic monitoring, and magnetic ranging capabilities.

May–August 2012: Environmental Inspector, Regulatory Department, City of Minneapolis, Minneapolis, Minnesota. Ms. Olsen's activities included the following:

- Inspected and conducted routine field investigations to resolve environmental problems such as noise, air quality, water quality, and soil pollution.
- Coordinated and prepared reports, research efforts, and mapping projects related to environmental projects and issues.
- Drafted and issued permits and ensured compliance through inspections.
- Reviewed and recommended permit denials, revocations, or administrative fines.
- Responded to private and public agencies for emergency response and reporting of emergency incidents and provided assistance to the city as required.
- Represented the Health Department in public meetings, public relations, media relations, and communications with elected officials and other stakeholders.

DR. JOHN A. TEMPLETON
Senior Geoscientist
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Principal Areas of Expertise

Dr. Templeton's principal areas of interest and expertise include structural geology, tectonics, sedimentology and stratigraphy, geophysical interpretation, and exploration geology.

Education and Training

Ph.D., Geology, Columbia University, 2015.
M.Div., Wake Forest University, 2004.
B.S., Geology and Chemistry, University of North Carolina, Chapel Hill, 2001.

Research and Professional Experience

2021–Present: Senior Geoscientist, EERC, UND. Dr. Templeton interfaces with a diverse team of scientists and engineers to assess project uncertainties in oil and gas development and geologic CO_2 storage, including developing geophysical models of the subsurface and performing regional geological characterization. In addition, he helps lead diversity, equity, inclusion, and accessibility (DEIA) efforts at the EERC.

2017–2021: Senior Geologist, Lower 48 New Ventures, ConocoPhillips. Dr. Templeton served as lead structural geologist for an exploration team focusing on Lower 48 opportunities in the Gulf Coast and Rocky Mountain basins.

2016: Senior Geologist, Permian Basin Development Team, ConocoPhillips. Dr. Templeton served as lead geologist for San Andres and Holt redevelopment on the Central Basin Platform focused on carbonate sequence stratigraphy and quantitative seismic stratigraphy.

2015: Geologist, Global New Ventures, ConocoPhillips. Dr. Templeton led a Southeast Asia regional project including Myanmar, Cambodia, and Vietnam.

2014: Intern, Subsurface Technology Clastic Stratigraphy Group, ConocoPhillips. Dr. Templeton's work focused on quantitative seismic stratigraphic interpretation of deepwater turbidite channel reservoirs in the Choctaw Basin, Gulf of Mexico.

2013: Intern, Sedimentology Research Group, Statoil, Norway. Dr. Templeton's work focused on sediment provenance of Triassic and Jurassic rift basins, North Sea, using detrital zircon thermochronology.

2011–2014: Teaching Assistant, Columbia University. Dr. Templeton served as Graduate Teaching Assistant for Plate Tectonics, Advanced General Geology, a Death Valley field course, and Introduction to the Solid Earth.

2008–2009: Assistant Teacher, Candler Elementary School, Candler, North Carolina. Dr. Templeton assisted with reading and math for second and fifth grade classrooms.

2008–2009: Interim Campus Minister, United Methodist Wesley Foundation, University of North Carolina, Asheville.

2006–2007: Youth and Children's Minister, First Baptist Church, Spruce Pine, North Carolina.

2005–2006: Associate Campus Minister, Mars Hill College, Mars Hill, North Carolina.

Publications

Dr. Templeton has authored and coauthored several professional publications.

DR. AGUSTINUS ZANDY
Principal Operations Specialist
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Principal Areas of Expertise

Dr. Zandy's principal areas of interest and expertise include drilling and completion design (Class I, Class II, and Class VI wells); production optimization and simulation; artificial lift design (gas lift and electric submersible pump); and drilling, logging, coring, well-testing, and production operations.

Education and Training

Ph.D., Petroleum Engineering, University of North Dakota, 2022.
M.S., Petroleum Engineering, University of North Dakota, 2017.
Bachelor's degree, Chemical Engineering, Bandung Institute of Technology, Indonesia, 2007.

Research and Professional Experience

October 2022–Present: Principal Operations Specialist, EERC, UND. Dr. Zandy's work focuses on working with project teams and EERC clients and leading efforts related to carbon capture, utilization, and storage (CCUS) projects; well drilling and completion designs; field activities related to drilling, logging, coring, and completion; well production/injection performance; and well test (step rate, extended, and fall-off tests) interpretation. Other responsibilities include mentoring junior team members; working with team members to prepare proposals; developing and managing projects, personnel, and budgets; preparing and managing the preparation of technical reports; delivering technical presentations; working with potential clients and service companies; and preparing and organizing technical documents related to drilling and injection permitting for Class I, II, and VI wells and storage facility permits.

August 2020–September 2022: Senior Operations Specialist, EERC, UND. Dr. Zandy worked with project teams and EERC clients to perform drilling and completion design; conduct field activities related to drilling, logging, coring, and completion; analyze artificial lift designs (gas lift and electric submersible pump); and evaluate well production/injection performance. Other responsibilities included mentoring junior team members; working with team members to prepare proposals; developing and managing projects, personnel, and budgets; preparing and managing the preparation of technical reports; delivering technical presentations, working with team members, clients, and potential clients; and preparing and organizing technical documents related to drilling and injection permitting for Class I, II, and VI wells.

2017–July 2020: Oilfield Operations Specialist, EERC, UND. Dr. Zandy's work focused on leading efforts related to the design and execution of oil and gas field activities such as well drilling, logging, downhole fluid sampling, coring, and well completion and analyzing hydraulic fracturing practices to look for optimization methods. Other responsibilities included working with team members to prepare proposals; develop and manage projects, personnel, and budgets; prepare and manage the preparation of technical reports, and deliver technical presentations, working with team members, clients, and

potential clients; prepare and organize technical documents related to drilling and injection permitting for Class I, II, and VI wells.

2016–2017: Research Assistant (part-time), EERC, UND. Dr. Zandy worked at the EERC while completing his M.S. degree, where his activities included initiating completion design for CO_2 sequestration and brine inject wells for CO_2 plume optimization projects and gathering and organizing technical documents related to drilling and injection permitting for Class I, II, and VI wells.

2015–2016: Senior Petroleum Engineer, Tiarabumi Petroleum, Jakarta, Indonesia. Dr. Zandy's activities included accelerating well production by 50% by conducting well service and ESP frequency adjustment; designing well completion (including artificial lift selection and well type) for three development wells; yielding 30% piping cost reduction by proposing a multifunctional dual-pipe system; and advancing production facility processes up to 99% by converting a batching to a continuous system, modifying the piping system and fluid flow at no cost.

2012: Completion Engineer, Total E&P Indonesie, East Kalimantan, Indonesia. Dr. Zandy's activities included formulating Medco's sand control selection methodology through sand control technology benchmarking and improving Medco's well service program template by providing a mitigation plan to minimize the job risk.

2010–2015: Petroleum Engineer, Medco E&P Indonesia, Jakarta, Indonesia. Dr. Zandy's activities included developing waterflood pattern optimization by identifying fluid flow direction and connectivity in the formation; introducing the interference test as methodology to identify flow unit connectivity in the Baturaja Formation, and analyzing the test results using Ecrin; formulating the best well completion design using WellFlo, which includes completion type, tubing size, artificial lift selection and installation schedule, perforation method, and specification and stimulation type, with various scenarios related to reservoir performance forecasting; executing a multistage acidizing operation using a coiled-tubing unit in a limestone reservoir with a reservoir contact of 2500 ft MD and total acid treatment volume of 1800 bbl, substantially increasing oil production; stimulating well production by selecting an optimum artificial lift, redesigning existing artificial lift (gas lift and ESP), and stimulating the reservoir; pioneering a monobore system for a marginal gas field well that reduced the drilling capital expenditures with no gas rate reduction; and introducing sand control selection methodology for an unconsolidated reservoir to minimize wellbore damage during production.

2007–2010: Asset Production Engineer, Medco E&P Indonesia. Dr. Zandy's activities included the following:

- Established a production and water injection network model using WellFlo and ReO that successfully increased total water injection rate by 20% and improved the piping system to reduce pipe operating pressure by 5–10 psig.
- Implemented an ESP–gas lift hybrid system that was successful in minimizing production loss by 30% during ESP system failure and installed with no failures.
- Coordinated slickline operations such as pressure–temperature downhole survey, resetting the gas lift valve, and inside mandrel (IM-Pack OFF) installation for gas lift deepening and tubing clearance, including electronic memory gauge programming and data receiving.
- Initiated intermittent gas lift installation in low-production wells, which successfully increased production by 50% from 12 wells.
- Established a water injection well stimulation schedule using rigless operation that effectively maintained the voidage replacement ratio (VRR) > 1.0.

Professional Activities
Member, Society of Petroleum Engineers

Publications
Dr. Zandy as coauthored several professional publications.

APPENDIX E

BUDGET NOTES

BUDGET NOTES

ENERGY & ENVIRONMENTAL RESEARCH CENTER (EERC)

BACKGROUND

The EERC is an independently organized multidisciplinary research center within the University of North Dakota (UND). The EERC is funded through federal and nonfederal grants, contracts, and other agreements. Although the EERC is not affiliated with any one academic department, university faculty may participate in a project, depending on the scope of work and expertise required to perform the project.

INTELLECTUAL PROPERTY

The applicable federal intellectual property (IP) regulations will govern any resulting research agreement(s). In the event that IP with the potential to generate revenue to which the EERC is entitled is developed under this project, such IP, including rights, title, interest, and obligations, may be transferred to the EERC Foundation®, a separate legal entity.

BUDGET INFORMATION

The proposed work will be done on a cost-reimbursable basis. The distribution of costs between budget categories (labor, travel, supplies, equipment, etc.) and among funding sources of the same scope of work is for planning purposes only. The project manager may incur and allocate allowable project costs among the funding sources for this scope of work in accordance with Office of Management and Budget (OMB) Uniform Guidance 2 Code of Federal Regulations (CFR) 200.

Escalation of labor and EERC recharge center rates is incorporated into the budget when a project's duration extends beyond the university's current fiscal year (July 1 – June 30). Escalation is calculated by prorating an average annual increase over the anticipated life of the project.

The cost of this project is based on a specific start date indicated at the top of the EERC budget. Any delay in the start of this project may result in a budget increase. Budget category descriptions presented below are for informational purposes; some categories may not appear in the budget.

Salaries: Salary estimates are based on the scope of work and prior experience on projects of similar scope. The labor rate used for specifically identified personnel is the current hourly rate for that individual. The labor category rate is the average rate of a personnel group with similar job descriptions. Salary costs incurred are based on direct hourly effort on the project. Faculty who work on this project may be paid an amount over the normal base salary, creating an overload which is subject to limitation in accordance with university policy. As noted in the UND EERC Cost Accounting Standards Board Disclosure Statement, administrative salary and support costs which can be specifically identified to the project are direct-charged and not charged as facilities and administrative (F&A) costs. Costs for general support services such as contracts and IP, accounting, human resources, procurement, and clerical support of these functions are charged as F&A costs.

Fringe Benefits: EERC fringe benefits consist of two components which are budgeted as a percentage of direct labor. The first component (26%) is a fixed percentage approved annually by the UND cognizant audit agency, the Department of Health and Human Services. This portion of the rate covers vacation, holiday, and sick leave (VSL) and is applied to direct labor for permanent staff eligible for VSL benefits.

The approved rate will be charged to the project. The second component (30%) is estimated on the basis of historical data and is charged as actual expenses for items such as health, life, and unemployment insurance; social security; worker's compensation; and UND retirement contributions. These benefits will be charged based on expenses actually incurred and will vary by individual.

Travel: Travel may include site visits, fieldwork, meetings, and conferences. Travel costs are estimated and paid in accordance with OMB Uniform Guidance 2 CFR 200, Section 474, and UND travel policies, which can be found at http://und.edu/finance-operations (Policies & Procedures, A–Z Policy Index, Travel). Daily meal rates are based on U.S. General Services Administration (GSA) rates unless further limited by UND travel policies; other estimates such as airfare, lodging, ground transportation, and miscellaneous costs are based on a combination of historical costs and current market prices. Miscellaneous travel costs may include parking fees, Internet charges, long-distance phone, copies, faxes, shipping, and postage.

Equipment: If equipment (value of $5000 or more) is budgeted, it is discussed in the text of the proposal and/or identified more specifically in the accompanying budget detail.

Supplies: Supplies include items and materials that are necessary for the research project and can be directly identified to the project. Supply and material estimates are based on prior experience with similar projects. Examples of supply items are chemicals, gases, glassware, nuts, bolts, piping, data storage, paper, memory, software, toner cartridges, maps, sample containers, minor equipment (value less than $5000), signage, safety items, subscriptions, books, and reference materials. General purpose office supplies (pencils, pens, paper clips, staples, Post-it notes, etc.) are included in the F&A cost.

Subcontract – Neset Consulting Service (Neset): Neset will be generating authorization for expenditures (AFE) for well design.

Subcontract – Stress Engineering: Stress Engineering will be providing materials testing.

Subcontactors – DOE Award: The DOE portion of Stage 2 includes 13 total subcontractors.

Contract Services – Earth Signal Processing: Earth Signal Processing will be providing legacy 2D seismic data.

Contract Services – TetraTech: Tetra Tech will be providing engineered well design.

Professional Fees: Not applicable.

Communications: Telephone, cell phone, and fax line charges are included in the F&A cost; however, direct project costs may include line charges at remote locations, long-distance telephone charges, postage, and other data or document transportation costs that can be directly identified to a project. Estimated costs are based on prior experience with similar projects.

Printing and Duplicating: Page rates are established annually by the university's duplicating center. Printing and duplicating costs are allocated to the appropriate funding source. Estimated costs are based on prior experience with similar projects.

Food: Expenditures for project partner meetings where the primary purpose is dissemination of technical information may include the cost of food. EERC employees in attendance will not receive per

diem reimbursement for meals that are paid by project funds. The estimated cost is based on the number and location of project partner meetings.

Professional Development: Fees are for memberships in technical areas directly related to work on this project. Technical journals and newsletters received as a result of a membership are used throughout the development and execution of the project by the research team.

Operating Fees: Operating fees generally include EERC recharge centers, outside laboratories, and freight.

EERC recharge center rates are established annually and approved by the university.

Laboratory and analytical recharge fees are charged on a per-sample, hourly, or daily rate. Additionally, laboratory analyses may be performed outside the university when necessary. The estimated cost is based on the test protocol required for the scope of work.

Document production services recharge fees are based on an hourly rate for production of such items as report figures, posters, and/or images for presentations, maps, schematics, Web site design, brochures, and photographs. The estimated cost is based on prior experience with similar projects.

Shop and operations recharge fees cover specific expenses related to the pilot plant and the required expertise of individuals who perform related activities. Fees may be incurred in the pilot plant, at remote locations, or in EERC laboratories whenever these particular skills are required. The rate includes such items as specialized safety training, personal safety items, fall protection harnesses and respirators, CPR certification, annual physicals, protective clothing/eyewear, research by-product disposal, equipment repairs, equipment safety inspections, and labor to direct these activities. The estimated cost is based on the number of hours budgeted for this group of individuals.

Engineering services recharge fees cover specific expenses related to retaining qualified and certified design and engineering personnel. The rate includes training to enhance skill sets and maintain certifications using Webinars and workshops. The rate also includes specialized safety training and related physicals. The estimated cost is based on the number of hours budgeted for this group of individuals.

Geoscience services recharge fees are discipline fees for costs associated with training, certifications, continuing education, and maintaining required software and databases. The estimated cost is based on the number of hours budgeted for this group of individuals.

Software solutions services recharge fees are for development of customized Web sites and interfaces, software applications development, data and financial management systems for comprehensive reporting and predictive analysis tools, and custom integration with existing systems. The estimated cost is based on prior experience with similar projects.

Field safety fees cover safety training and certifications, providing necessary PPE, and annual physicals. The estimated cost is based on the number of days individuals are budgeted to work in the field.

Freight expenditures generally occur for outgoing items and field sample shipments.

Facilities and Administrative Cost: The F&A rate proposed herein is approved by the U.S. Department of Health and Human Services and is applied to modified total direct costs (MTDC). MTDC is defined as total direct costs less individual capital expenditures, such as equipment or software costing $5000 or more with a useful life of greater than 1 year, as well as subawards in excess of the first $25,000 for each award.

Cost Share: For Stage 1, Rainbow Energy Center is providing $1,350,000 of cash cost share. For Stage 2, Rainbow Energy Center is providing $4,769,691 of cash cost share for a project total of $6,119,691. Stage 2 cost share is contingent on being selected for $38,148,520 of U.S. Department of Energy funding.