



February 14, 2018

Ms. Karlene Fine
North Dakota Industrial Commission
State Capitol 14th Floor
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Dear Ms. Fine:

Subject: Proposal Entitled “Fryburg and Medora Unitized Fields: Prototypes for Revitalizing Conventional Oil Fields in North Dakota” in Response to the North Dakota Industrial Commission Oil and Gas Research Program Solicitation

Eagle Energy Partners I, LLC (EEPI) is pleased to propose a research program designed to encourage and promote the use of new technologies that have a positive economic and environmental impact on oil and gas exploration and production in North Dakota. The EEPI team has worked together and been involved with all aspects of North Dakota’s oil and gas industry for the past 35 years. The team has a proven record of successfully unitizing and applying secondary recovery techniques to multiple conventional oil fields in the Williston Basin. We see the proposed research of revitalizing legacy conventional oil fields via the prudent application of tertiary enhanced oil recovery (EOR) techniques as an opportunity to not only address the objectives of the Oil and Gas Research Program (OGRP), but also to make major strides toward achieving Governor Burgum’s goal of 2 million barrels per day of statewide oil production. The proposed research will lay technical groundwork that informs investment decisions and prudent development strategies for operators seeking to produce incremental oil from North Dakota’s conventional oil fields.

EEPI believes the potential long-lasting economic and technological benefits of the proposed research far exceed the requested \$3 million investment from the OGRP and is prepared to leverage OGRP funds with \$3,000,000. EEPI is in the process of acquiring the unitized Fryburg and Medora Fields (closure scheduled in Q1 of 2018), with the intent to revitalize these established conventional fields by optimizing secondary waterflood of the Heath (Tyler) and Madison producing intervals in preparation for tertiary CO₂ EOR.

EEPI is confident that its commitment to provide professional and financial resources, as well as providing our project partner, the Energy & Environmental Research Center (EERC), with the necessary access to information, field infrastructure, operational and technical support, and other such items as necessary, will successfully accomplish the proposed research program and bring tremendous value to the OGRP. Enclosed please find an original and one copy of the subject proposal along with a check for \$100. This transmittal letter represents a binding commitment by EEPI to complete the project described in this proposal. If you have any questions, please contact me by telephone at (701) 837-4780 or by e-mail at eagleop@yahoo.com.

Sincerely,

Robert Mau
President, Chairman/Operator



February 14, 2018

Ms. Karlene Fine
North Dakota Industrial Commission
State Capitol 14th Floor
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Dear Ms. Fine:

Subject: Affidavit of North Dakota Tax Liability for Eagle Energy Partners I, LLC

Please accept this letter as an affidavit that Eagle Energy Partners I, LLC does not have an outstanding tax liability owed to the State of North Dakota or any of its political subdivisions.

If you have questions, please contact me by telephone at (701) 837-4780 or by e-mail at eagleop@yahoo.com.

Sincerely,

Pat Nickodemus
Secretary/Treasurer

AFFIDAVIT of NORTH DAKOTA TAX LIABILITY

STATE OF Colorado)

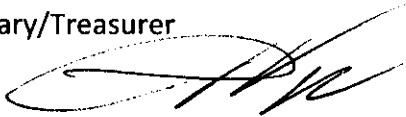
COUNTY OF Larimer)

Before me, Taylor Sherer, a Notary Public in and for the said County and State, this day personally appeared Pat Nickodemus who being first duly sworn, deposes and says that (s)he is employed by _____ Eagle Energy Partners I, LLC _____, that (s)he states that the following information is within his personal knowledge and is true:

Eagle Energy Partners I, LLC does not have an outstanding tax liability owed to the State of North Dakota or any of its political subdivisions.


Printed Name of Representative: Pat Nickodemus

Title: Secretary/Treasurer

Signature: 

Address: 2501 6th Street SE, Minot, ND 58701

Subscribed in my presence and sworn before me this 13th day of February, 2018

NOTARY PUBLIC FOR COLORADO 

My Commission Expires July 19, 2020

Taylor Sherer
Notary Public
State of Colorado
Notary ID 20164027431
My Commission Expires July 19, 2020

Oil and Gas Research Program

North Dakota

Industrial Commission



Application

Project Title: Fryburg and Medora Unitized Fields:
Prototypes for Revitalizing Conventional Oil Fields
in North Dakota

Applicant: Eagle Energy Partners I, LLC (EEPI)

Principal Investigator: Pat Nickodemus

Date of Application: February 14, 2018

Amount of Request: \$3,000,000

Total Amount of Proposed Project: \$6,000,000

Duration of Project: 36 months

Point of Contact (POC): Pat Nickodemus

POC Telephone: (907) 556-0814

POC E-Mail Address:

pat@eagleenergypartnersllc.com

POC Address:

2501 6th Street Southeast, Suite B

Minot, ND 58701

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ABSTRACT

Eagle Energy Partners I, LLC (EEPI) proposes a multidisciplinary research program to address the technical challenges facing the revitalization of conventional reservoirs in North Dakota. EEPI intends to investigate the Fryburg Heath (Tyler)–Madison and Medora Heath–Madison unitized fields (FHMU and MHMU, respectively) in Billings County as prototypes for implementing CO₂ enhanced oil recovery (EOR) in North Dakota. EEPI proposes to conduct the program in close collaboration with the Energy & Environmental Research Center (EERC). Information generated in this project will positively affect ultimate recovery from North Dakota’s existing conventional oil pools and will lead to additional projects, processes, ideas, and activities to facilitate implementation of oil exploration and production technologies presently not used in the state. The potential to revitalize conventional oil fields and increase ultimate recovery will bring new oil companies and industry investment to North Dakota, resulting in the growth of oil and gas jobs, wealth, and tax revenues for North Dakota.

Objective: Investigate waterflood optimization as a precursor for CO₂ EOR and development pathways for FHMU and MHMU as prototypes for the revitalization of conventional oil fields in North Dakota. Objectives to be accomplished to meet the stated goal are 1) evaluate waterflood optimization and CO₂ EOR potential and implementation approaches specific to FHMU and MHMU; 2) develop cost-effective operational strategies that address key technical challenges, optimize current facilities, and systematically consider necessary new facilities; and 3) frame the results and experiences from this project as a prototype for revitalizing Tyler and Madison conventional oil fields in North Dakota.

Expected Results: New information to enable operators, investors, regulators, and other stakeholders to make informed decisions regarding the revitalization of North Dakota’s vast conventional oil resources.

Duration: 36 months (May 1, 2018, to April 30, 2021).

Total Project Cost: \$6,000,000. The amount requested from the Oil and Gas Research Program is \$3,000,000. At least \$3,000,000 in cofunding will be provided by EEPI.

Participants: EEPI and the EERC. A letter of commitment from the EERC can be found in Appendix A.

PROJECT DESCRIPTION

Objectives: Recent studies indicate 280 MMbbl to over 630 MMbbl of incremental oil recovery potential through the use of tertiary CO₂ EOR in 86 North Dakota unitized conventional oil fields (NDLM, 2014). The goal of the proposed research program is to enable revitalization of unitized conventional oil fields in North Dakota, ultimately resulting in increased daily oil production and prolonging the operational lifetime of those fields. The three major objectives to meet this goal are 1) evaluate waterflood optimization and CO₂ EOR potential and implementation approaches specific to FHMU and MHMU; 2) explore operational strategies that address key technical challenges, optimize current facilities, and systematically consider necessary new facilities; and 3) frame project results and experiences as a prototype for revitalizing Tyler and Madison conventional oil fields in North Dakota.

The first objective will be achieved by using new and existing geologic and reservoir engineering characterization data (e.g., core analyses, well logs, oil analyses) and modeling/simulation to optimize waterflood operations in preparation of near-term CO₂-based EOR operations. To achieve the second objective, results of new characterization and geologic assessments will be combined with refined performance forecasts to conduct CO₂ EOR scenario analysis. The results will be used to develop strategies for the design and operation of prudent EOR schemes that will be applicable to other unitized fields producing from the same pools. The third objective will be achieved through the synthesis of the project results into a guidance document for producers and investors looking to revitalize conventional Tyler and Madison reservoirs in North Dakota with CO₂-based EOR.

FHMU and MHMU have been under waterflood since the early 1970s and are promising candidates for CO₂ EOR (Burke, 2005; NDLM, 2014). Information generated from the investigation of these two unitized fields will be directly applicable to at least 14 other unitized fields in the region producing from the same horizons (Figure 1). North Dakota has no commercial tertiary CO₂ EOR operations currently, and the knowledge gained through the proposed research will serve to derisk the implementation of future CO₂ EOR projects and thus attract investment in the North Dakota oil and gas industry. Applying project

results to other fields may bring new CO₂ EOR activity to the state, resulting in a significant contribution to OGRP goals and Governor Burgum’s challenge of producing 2 MMbpd of oil. The proposed research will contribute to the development of North Dakota’s endowment of oil and benefit areas of the state beyond the extent of current Bakken petroleum system (BPS) production.

Methodology: EEPI will work closely with the EERC to implement a research program that includes detailed geologic characterization

and to develop infrastructure and operating strategies to optimize waterflood operations as a precursor to CO₂ EOR. Key findings of the project will be integrated into a prototype field development plan that informs a guidance document to revitalize conventional reservoirs. The activities in the proposed project are organized within two tasks.

Task 1. Assessing the Potential of FHMU and MHMU.

Subtask 1.1. Data Reconnaissance and Conditioning. Much of the data needed to accurately and successfully complete the goal of the proposed project is available through either publicly available sources (e.g., North Dakota Industrial Commission [NDIC] database, scholarly studies) or available from EEPI once field acquisition is complete (scheduled for first quarter of 2018). A gap analysis process will identify missing key data and guide new data acquisition. Existing data (e.g., well logs, well files, core data, fluid and rock properties) are in a variety of formats and will require conditioning prior to use. Subtask 1.1 comprises the activities to compile, organize, manage, screen, vet, digitize, and interpret the various types of data for integration in Subtasks 1.2 and 1.3 and reporting.

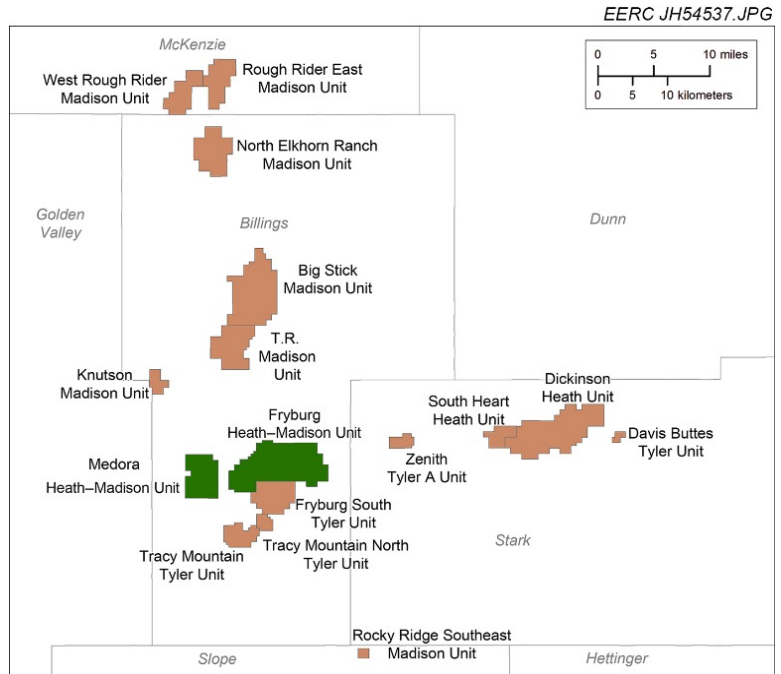


Figure 1. Unitized fields producing from the same formations as the FHMU and MHMU.

Subtask 1.2. Reservoir Modeling and Engineering. Subtask 1.2 activities include geologic and engineering characterization of FHMU and MHMU. Geologic and simulation models representative of the geology and physical performance of the FHMU and MHMU will be constructed, history-matched, and calibrated. The geologic and simulation models will be assessed based on sensitivity and uncertainty in performance to define and prioritize data needs to be addressed through Subtask 1.4. New field and laboratory data produced through Subtask 1.4 will refine the geologic and simulation models. EEPI and EERC experience with waterflood and CO₂ EOR projects, combined with simulated performance data from scenario analyses (e.g., horizontal wells, infill drilling, commingled production, flood patterns, process rates, water alternating gas vs. continuous CO₂ injection), will define and evaluate development strategies and operating scenarios to optimize waterflood performance as a precursor to CO₂ EOR.

Subtask 1.3. Operability Assessment. Existing facilities, infrastructure, and data monitoring used in FHMU and MHMU will be assessed with the development strategies and operating scenarios investigated in Subtask 1.2. Data collection, management, and a facilities upgrade plan for the fields will be developed for selected pertinent development strategies.

Subtask 1.4. Strategic Characterization. Based on the results of Subtasks 1.2 and 1.3, new data will be collected, analyzed, and interpreted (e.g., well logs, pressure testing, production profiles, core testing) to support the research program. Results will be integrated into Subtask 1.2 to calibrate and improve geologic and simulation model performance and in Subtask 1.3 to ultimately evaluate operating scenarios and inform development strategies to revitalize FHMU and MHMU.

Task 2. Prototype to Revitalize Tyler and Madison Plays. Task 2 will synthesize Task 1 activities and results (e.g., performance response derived from scenario analysis) to assess potential development strategies for CO₂ EOR that can be applied to revitalize oil fields producing from the Tyler and Madison Formations in North Dakota. This information will be incorporated into a guidance document and included as part of the final report (D6).

Proposed Deliverables (D)

D1 – Quarterly Reports: Quarterly progress reports will be submitted to the NDIC 30 days after the end of each calendar quarter.

D2 – Data Needs Analysis – Priorities for Revitalization: Based on EEPI and EERC experience, combined with geologic and simulation model results, a list of required/preferred geologic and operational data to characterize a reservoir for waterflood and CO₂ EOR will be compiled. Using this compilation, a gap analysis will be performed for FHMU and MHMU to ascertain any data needs required to revitalize these units using CO₂ EOR. These needs will be prioritized based on intended use, scarcity, cost, and benefits. A document (D2) will be created describing this process that can be applied by operators seeking to revitalize similar oil fields in North Dakota. D2 will be provided to NDIC at the end of Year 1.

D3 – Facilities Assessment – Opportunities and Challenges for Revitalization: Based on EEPI and EERC experience, a list of required/preferred infrastructure for the operation and management of a waterflood as a precursor to CO₂ EOR will be compiled (e.g., fluid separation and handling facilities, pipelines, wells) to evaluate selected operating scenarios and to inform development strategies. This list will be compared to existing infrastructure at FHMU and MHMU to ascertain needs required to revitalize these units for CO₂ EOR. A document (D3) will be created that describes infrastructure needs, opportunities, challenges, and priorities for operators and stakeholders looking to revitalize similar oil fields in North Dakota. D3 will be provided to NDIC at the end of Year 1.

D4 – Surveillance and Data Integration – Priorities for Revitalization: Operational (e.g., wellhead pressures and production rates) and reservoir (e.g., formation pressure and fluid saturation) surveillance play an important role in the prudent optimization and management of secondary production in preparation for CO₂ EOR. D2 and D3 results will be combined to generate a plan to collect and integrate reservoir and operational surveillance data as part of a project management strategy. Factors such as data acquisition and integration cost, environmental and operational impacts, etc., will be used to develop a

document (D4) that discusses surveillance needs, opportunities, challenges, and priorities for operators and stakeholders seeking to revitalize unitized Tyler and Madison oil fields in North Dakota. D4 will be supplied to NDIC at the conclusion of Subtask 1.3.

D5 – Technology Transfer and Progress Update: A PowerPoint presentation (D5) outlining progress and results generated over the prior year will be submitted to NDIC at the completion of Years 1 and 2. EEPI and the EERC will also work with OGRC and the North Dakota Petroleum Council to identify and implement opportunities for EOR education in North Dakota.

D6 – Final Report: A final report (D6) will be submitted to NDIC at the end of Year 3 providing pertinent information regarding key technical challenges, flood design strategies, infrastructure priorities, data acquisition priorities, and sensitivity studies with regard to optimizing secondary production from Tyler and Madison oil fields in preparation for CO₂ EOR. D6 will include a guidance document providing new information to enable operators, investors, regulators, and other stakeholders to make informed decisions regarding the revitalization of North Dakota’s vast conventional oil resources. Simulated production and performance response from the pertinent scenario analysis cases will be included.

Anticipated Results: This project will enable implementation of production practices not presently used in North Dakota to positively affect ultimate recovery from existing conventional oil pools. Results of this project may ultimately lead to additional projects, processes, ideas, and activities to implement oil exploration and production technologies to revitalize conventional oil fields in the state. Literature indicates that quality secondary recovery is often a harbinger of successful tertiary recovery. To support the design of quality secondary recovery operations, the proposed activities will generate results and guidance that provide North Dakota producers with a prototype for optimizing waterflood in the Tyler and Madison Formations as a precursor to CO₂ EOR. Priorities for data collection and integration, operational monitoring, and facility upgrades will be generated. Combined with reservoir engineering that defines and evaluates waterflood and CO₂ EOR operating scenarios pertinent to FHMU and MHMU, the proposed activities will provide information critical to inform prudent strategies to revitalize Tyler and

Madison oil fields in North Dakota. Likewise, the results will provide an improved understanding of production potential for underexploited oil-producing formations. The infrastructure and facility priorities necessary for implementation of CO₂ EOR will be identified, including modifications and upgrades to supervisory control and data acquisition (SCADA) systems and fluid-handling facilities.

Facilities: After successful acquisition, EEPI will have full operational control and access to FHMU and MHMU and associated infrastructure and data archives. The EEPI team has decades of experience operating oil fields under primary production and waterflood and will manage all field operations.

A majority of the data collection and conditioning, reservoir characterization, modeling, laboratory analysis, facilities assessment, and product development work will be conducted at EERC facilities in Grand Forks, North Dakota. Modeling hardware at the EERC includes a high-performance computer cluster dedicated to advanced reservoir modeling and simulations. The EERC uses industry standard modeling and simulation software and has staff proficient in their use. EERC facilities include several laboratories and personnel with more than two decades of experience conducting standard and advanced core and fluid studies related to CO₂ EOR, including geomechanical, petrographic, geochemical, exposure and flow-through studies. The EERC has x-ray diffraction (XRD), x-ray fluorescence (XRF), and scanning electron microscopy (SEM) systems, as well as the ability to conduct wet-chemistry and advanced hydrocarbon and trace elemental analyses. The EERC's staff encompass geology, chemistry, physics, and engineering disciplines. The EERC has decades of experience related to CO₂ EOR and has led a broad range of research in support of North Dakota oil and gas research activities such as the Plains CO₂ Reduction (PCOR) Partnership Program and Bakken Production Optimization Program (BPOP).

Resources: A key resource for this project will be unique and full access to all components of FHMU and MHMU. EEPI will provide access to the historical data archive for both units, including reservoir characterization, production, and operational data not available in NDIC well files. The wells and facilities that comprise the FHMU and MHMU assets will be available to the technical team to support the project activities as necessary. Information generated through new characterization, testing, well

logging, and workover activities conducted in FHMU and MHMU during the project will be incorporated into the project tasks. EEPI is committed to providing operational expertise and personnel to conduct fieldwork as necessary to facilitate the completion of proposed activities. Such work may include well testing, fluid and rock sampling, well logging, pressure monitoring, etc. Core for these fields are stored at the North Dakota Geological Survey's Core and Sample Library.

EEPI and the EERC will work closely with NDIC through project meetings and quarterly reporting to ensure project quality and timeliness. The educational contribution of the project will be fulfilled by conference presentations and publications, which may include presentations at the Williston Basin Petroleum Conference, public reporting (Deliverables 1–6), and engagement with the North Dakota Petroleum Council's outreach and education program.

Techniques to Be Used, Their Availability and Capability: Core-based studies will be conducted on core readily available at the North Dakota Geological Survey's Core and Sample Library in Grand Forks.

Fluids studies will employ fluids collected from FHMU and MHMU. All core-based analytical activities will be conducted at or managed by the EERC and will use industry standard techniques. The EERC will determine MMP for oil from FHMU and MHMU with various CO₂ purities and reservoir conditions using the VIT (vanishing interfacial tension) technique (Hawthorne and others, 2016). Rock and fluid studies related to gas mobility, rock fluid interactions, relatively permeability, etc., will be conducted as needed, based on data requirements and priority.

Industry standard geologic characterization and reservoir engineering practices will be employed. Static and dynamic modeling activities will be conducted on computer hardware and software currently existing at the EERC. All personnel, equipment, space, and software to conduct the laboratory and modeling activities will be available through the duration of the project.

Environmental and Economic Impacts While Project Is under Way: The majority of the project will be conducted at the EERC. Fieldwork in FHMU and MHMU will be conducted following industry standard practices; thus minimal environmental impact is expected. Over the 3-year period of performance an

uptick in production, labor, and associated revenues is expected at FHMU and MHMU as EEPI implements the results of the research and prepares the units for waterflood as a precursor to CO₂ EOR.

Ultimate Technological and Economic Impacts: The proposed research will contribute to the development of North Dakota's oil resources, benefitting an area beyond the extent of current BPS production. The potential to revitalize conventional oil fields and increase ultimate recovery will bring new oil companies and industry investment to North Dakota, resulting in the growth of oil and gas jobs, wealth, and tax revenues. Recent studies indicate a minimum of 280 MMbbl to over 630 MMbbl of incremental oil recovery potential through the use of tertiary CO₂ EOR in 86 unitized conventional oil fields (NDLM, 2014). Assuming an average oil price of \$50/bbl and a 5% production tax rate, this incremental oil is worth between \$14 billion and \$30 billion, with \$0.7 billion to \$1.5 billion tax revenue.

Why the Project Is Needed: Although current productivity in the BPS is bullish and appears sustainable for at least the coming decade, maximizing the productivity of conventional oil resources is essential to achieving Governor Burgum's challenge of 2 MMbpd of oil and for maintaining long-term economic growth of the oil industry in North Dakota. The proposed activities are necessary to revitalize North Dakota's conventional oil fields through tertiary EOR. The results of the project will provide industry and the state of North Dakota with a foundation for developing a pathway to economically improve oil recovery from conventional fields.

North Dakota currently has no commercial CO₂ EOR projects in conventional fields. In addition, production is declining in conventional fields in part because of a lack of investment because of the focus on BPS. One of the primary challenges in increasing production via CO₂ EOR in conventional oil fields, particularly with respect to CO₂, is attracting substantial capital investment in oil fields that are perceived as being in their final stages of productivity. This project will generate the new information and knowledge necessary to improve the probability of bringing to North Dakota the investment necessary to realize the state's fullest oil production potential. At least 14 other Tyler and/or Madison unitized fields are within 30 miles of FHMU and MHMU. The information generated by this project may be adapted to

revitalize other fields that, if successfully applied, could increase production rates, more than double oil recoveries, and prolong their operational life. Revitalization using CO₂ EOR will require infill drilling and construction of new infrastructure and facilities. In short, revitalizing conventional oil fields will contribute to oil production and create new oil and gas jobs, wealth, and tax revenues for North Dakota for decades to come.

STANDARDS OF SUCCESS

Success will be measured according to the timely achievement of project milestones and development of deliverables. The project's value to North Dakota is an understanding of the challenges associated with optimizing waterfloods prior to CO₂ EOR in conventional reservoirs. Results may directly influence industry practices and lead to improved oil recovery (~630 MMbbl incremental recovery potential). Commercial CO₂ EOR operations in conventional oil fields typically last over 20 years. Successful application of CO₂ EOR in conventional resources underperforming their ultimate production potential could provide additional jobs and extend the life span of those jobs by another two decades. Commercial use of the project's results will rely not only on the nature of those results, but also on the availability of commercial CO₂. Although current CO₂ supplies in the Williston Basin are limited, projects to bring additional CO₂ to the EOR marketplace are in various stages of development within the next decade (e.g., Denbury Resources planning to extend its Greencore CO₂ pipeline to North Dakota [U.S. News and World Report, 2017] and several industrial sources investing in CO₂ capture investigation [Office of U.S. Senator John Hoeven, 2016; Voegelé, 2017]). Success of the project will also be based on the development of new data sets and technical documents for public dissemination. High-quality publications for an oil and gas audience will be made available to OGRP and organizations like SPE (Society of Petroleum Engineers).

BACKGROUND/QUALIFICATIONS

Pat Nickodemus will be the project manager and principal investigator (PI) on the project. Other key personnel include Bob Mau of EEPI and EERC personnel John Harju, John Hamling, Jim Sorensen, Wes

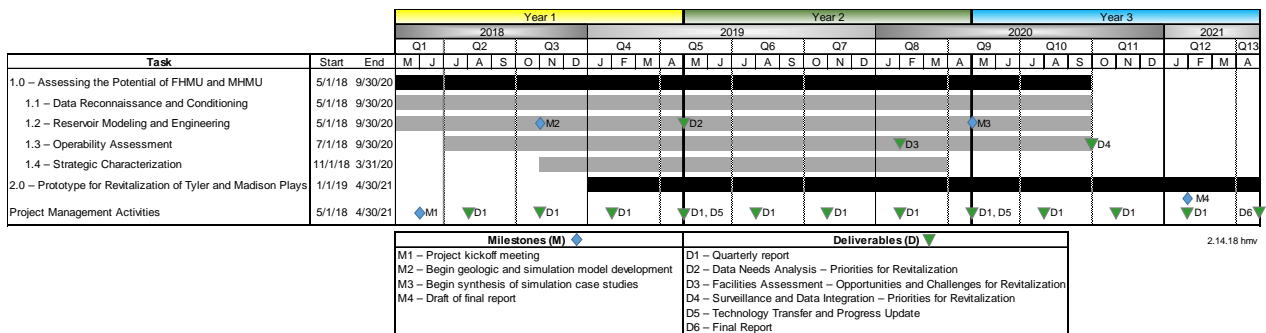
Peck, and Larry Pekot. Resumes of key personnel are provided in Appendix C. EEPI is an integrated team of operators, engineers, and investors working in all aspects of the oil and gas industry for the past 35 years. Members of the EEPI team have a proven record of successfully applying secondary recovery techniques to multiple conventional oil fields in the Williston Basin.

The EERC is a high-tech, nonprofit branch of UND that operates like a business and is dedicated to moving applied research into the commercial marketplace. The EERC, practicing under a long-standing philosophy of collaboration and an interdisciplinary approach, brings a specialized technical group focusing on design and implementation of new approaches to the exploration, development, and production of oil and gas. Previous EERC projects have focused on EOR in conventional and unconventional oil fields in the Powder River, Williston, and Alberta Basins. Since 2008, the EERC has managed and executed more than \$105 million of research funded by DOE in support of industry efforts to improve and optimize oil production from conventional and unconventional resources.

MANAGEMENT

Deliverables and milestones will be incorporated into a contractual agreement to ensure the project is being carried out on schedule and in a manner that best ensures the objectives will be met. Progress reports will be prepared on a quarterly basis (due 30 days at the end of each calendar quarter) and will serve as a means of evaluating the project with respect to budget, schedule, and technical achievement. The evaluation points (i.e., deliverables and milestones) are identified in the following Gantt chart.

TIMETABLE



BUDGET

The estimated cost for the 3-year project is \$6,000,000. This proposal requests \$3,000,000 from NDIC through its OGRP, and EEPI commits to providing at least \$3,000,000 in cofunding, on top of the substantial unenumerated value of free and ready access to wells, data, and facilities, as shown in the table below. Of EEPI's contribution, at least \$1,500,000 will be in the form of engineering and field services (e.g., reservoir testing, well workovers, collection of fluid samples) and \$1,500,000 will contribute toward the EERC's total subcontract of \$4,500,000.

Project Associated Expense	NDIC Share	EEPI Share (cash)	Total
Engineering and Field Services	\$ -	\$ 1,500,000	\$ 1,500,000
Subcontractor – EERC	\$ 3,000,000	\$ 1,500,000	\$ 4,500,000
Total Project Cost	\$ 3,000,000	\$ 3,000,000	\$ 6,000,000
Cost Share	50.0%	50.0%	100.0%

The EERC will provide technical (analytical, laboratory, and reservoir engineering) and managerial support for this effort. Appendix A contains a letter of commitment from the EERC and a budget. If the requested amount of funding is not available, the stated goals and objectives will be unattainable because project success is directly tied to integration of the proposed technical activities.

CONFIDENTIAL INFORMATION

Although there is no confidential information included in the proposal, there is a reasonable expectation that confidential information will be involved in, or created during, the execution of the project. In such cases, confidential information will be withheld from public disclosure. However, the intent of the project is to make as much information publically available as possible while protecting the interests of EEPI.

PATENTS/RIGHTS TO TECHNICAL DATA

Patents or rights do not apply to this proposal.

STATUS OF ONGOING PROJECTS (IF ANY)

EEPI has not previously been awarded OGRP funding.

APPENDIX A
EERC LETTER OF SUPPORT

February 15, 2018

Mr. Robert Mau
President, Chairman/Operator
Eagle Energy Partners I, LLC
2501 6th Street Southeast, Suite B
Minot, ND 58701

Dear Mr. Mau:

Subject: EERC Proposal No. 2018-0066 Entitled “Revitalizing Conventional Oil Fields in North Dakota”

The Energy & Environmental Research Center (EERC) is excited to support Eagle Energy Partners I, LLC, in its proposal to the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP) entitled “**Fryburg and Medora Unitized Fields: Prototypes for Revitalizing Conventional Oil Fields in North Dakota.**” The proposed scope of work directly aligns with the NDIC OGRP mission to *promote the growth of the oil and gas industry through research and education* and the EERC’s vision to *lead the world in developing solutions to energy and environmental challenges through innovative science and engineering.*

As part of the proposed research effort, the EERC will work closely with Eagle Energy Partners I, LLC, to investigate CO₂ enhanced oil recovery (EOR) potential and develop pathways for the Heath (Tyler) and Madison pools of the unitized Medora and Fryburg Fields as prototypes for the revitalization of conventional oil fields in North Dakota. Specific activities to be conducted by the EERC will include 1) reconnaissance and conditioning of historical data from both fields; 2) geologic assessment and reservoir engineering, including generation of geomodels and reservoir simulations to define and evaluate prudent revitalization strategies and prioritize data needs; 3) strategic characterization, including new reservoir testing and laboratory-based rock and fluid studies to improve simulation performance; 4) an operability assessment and priorities for infrastructure and monitoring implementation; 5) recommendations for EOR schemes and modifications to infrastructure, facilities, and operational parameters necessary for optimizing waterflood operations in preparation for future CO₂ EOR; and 6) synthesis of project results into products that can be used to guide stakeholders looking to revitalize conventional reservoirs in North Dakota.

Execution of the proposed research will contribute to the development of North Dakota’s endowment of oil, benefiting areas beyond the extent of current Bakken petroleum system production. Although 95% of North Dakota’s production comes from the unconventional Bakken and Three Forks plays, billions of barrels of oil are still in place within the state’s conventional oil fields. Those fields, many of which were established decades ago, are prime candidates for revitalization. The application of modern techniques for characterization, modeling, development, and management of established fields in the Tyler and Madison Formations will provide broadly applicable information that can improve resource estimates and inform efficient recovery strategies throughout the Williston Basin. The products from proposed research will empower producers with information that can be applied to better assess recovery

Mr. Mau/2
February 15, 2018

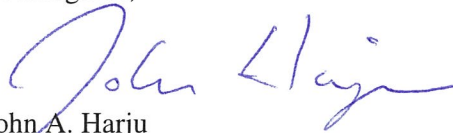
potential; inform prudent operational strategies, including optimization of secondary recovery to prepare for tertiary EOR; and contribute to the development of tertiary CO₂ oil recovery projects throughout the Williston Basin.

The revitalization of conventional resources such as those in the Madison and Tyler Formations will directly contribute to Governor Burgum's North Dakota production challenge of exceeding 2 million barrels of oil per day. The project may also contribute to potential proliferation of CO₂ EOR in North Dakota, providing synergistic benefits to potential CO₂ providers and leading to a cleaner energy future for North Dakota.

As a premier research entity with experience managing OGRP projects, the EERC is committed to managing the proposed project on behalf of Eagle Energy Partners I, LLC. We are prepared to leverage our experience and provide the necessary technical resources to ensure the successful execution and fulfillment of reporting requirements for the research activities. Should the project be awarded, the EERC will perform these activities for the estimated cost of \$4,500,000 over 36 months. Payment terms will be determined during contract negotiations.

We believe that the potential long-lasting economic and technological benefits of the proposed research far exceed the requested investment from NDIC OGRP and Eagle Energy Partners I, LLC. We look forward to collaborating with Eagle Energy Partners I, LLC, and NDIC on this exciting revitalization effort. If you have any questions, please contact me by phone at (701) 777-5157 or by e-mail at jharu@undeerc.org.

Best regards,



John A. Harju
Vice President for Strategic Partnerships

Approved by:



Thomas A. Erickson, Director
Energy & Environmental Research Center

JAH/kal

BUDGET

EERC Proposal No. 2018-0066
Revitalizing Conventional Oil Fields in North Dakota

Project Associated Expense	NDIC Share (Cash)	EEPT Share (Cash)	Total Project
Labor	\$ 1,747,601	\$ 927,575	\$ 2,675,176
Travel	\$ 20,600	\$ 5,286	\$ 25,886
Supplies	\$ 10,827	\$ 3,173	\$ 14,000
Communications	\$ 352	\$ 248	\$ 600
Printing & Duplicating	\$ 2,021	\$ 385	\$ 2,406
Food	\$ 2,323	\$ -	\$ 2,323
Laboratory Fees & Services			\$ -
GC/MS Lab	\$ 150,000	\$ -	\$ 150,000
Graphics Service	\$ 9,632	\$ 832	\$ 10,464
Outside Lab	\$ 50,000	\$ -	\$ 50,000
Facilities & Admin. Rate	\$ 1,006,644	\$ 562,501	\$ 1,569,145
Total Project Cost	\$ 3,000,000	\$ 1,500,000	\$ 4,500,000

APPENDIX B

RELEVANT EERC LABORATORY CAPABILITIES

RELEVANT EERC LABORATORY CAPABILITIES

Applied Geology Laboratory

- Full preparation laboratory, including slab saw, core drills, micronizing mill, and thin-section mill
- Petrographic microscopes using plane- and cross-polarized transmitted light
- Nanovea PS 50 optical profilometer
- Forney 20+-ton universal compression frame
- Trautwein-Geotac flexible wall permeameter
- Hoek-style triaxial and core-flood cells
- Teledyne Isco high-pressure fluid pumps
- Gas porosimeter/pycnometer
- Terraplug RS125 supergamma spectrometer
- Dead weight consolidation frames
- Thermal dilatometer
- Ion chromatograph
- Distillation, saturation, and chemistry equipment

Natural Materials Analytical Research Laboratory

- 4200-square-foot laboratory facility
- JEOL 5800 scanning electron microscope with NORAN instruments energy-dispersive spectrometer (EDS) detector system, GW Electronics enhanced backscatter detector, and NORAN instruments microanalysis system
- JEOL 5800 LV with Princeton Gamma-Tech Spirit Instruments EDS and microanalysis system and a HKL Technology electron backscatter diffraction system.
- QEMSCAN[®]
- Rigaku ZSK Primus II x-ray fluorescence system
- Bruker AXS D8 advanced x-ray diffraction system

Analytical Research Laboratory

- 4200-square-foot, fully equipped, exceedingly clean laboratory with seven fume hoods
- VG PQ ExCell inductively coupled plasma–mass spectrometer (ICP–MS) with collision cell technology
- PS Analytical Millennium Merlin cold-vapor atomic fluorescence spectrometer (CVAFS)
- PS Analytical Millennium Excalibur hydride generation atomic fluorescence spectrometer (HGAFS)
- Varian Spectra AA-880Z graphite furnace atomic absorption spectrometer (GFAAS)
- Mitsubishi TOX-100 chlorine analyzer with oxidative hydrolysis microcoulometry
- Perkin Elmer Optima 2100 ICP–AES
- Dionex ISC3000 ion chromatograph (IC) with conductivity detection
- Dionex 2020i IC with UV–VIS, conductivity, and electrochemical detection
- CEM MDS 2100 microwave with temperature and pressure control
- Pyrohydrolysis/ion-specific electrode for fluorine analysis of fossil fuels

APPENDIX C

RESUMES OF KEY PERSONNEL

PAT NICKODEMUS

Principal, Operations & Investor Relations
Eagle Energy Partners I, LLC (EEPI)
2501 6th Street Southeast, Suite B, Minot, North Dakota 58701
Phone: 970.556.0814, E-Mail: pat@eagleenergypartnersllc.com

Professional Summary

Mr. Pat Nickodemus, Principal, Operations & Investor Relations at EEPI, has 20+ years of C-level risk management and operations experience, specializing in insurance, safety, and risk management solutions for both upstream and midstream oil and gas companies. He holds a B.S. degree in Finance and Marketing from Chadron State College, Chadron, Nebraska.

- 20+ years C-level risk management and operations experience, specializing in insurance, safety and risk management solutions for both upstream and midstream oil and gas companies
- Assisted in developing insurance coverage forms for oil and gas operators and contractors
- Began working in ND oil and gas insurance in the 1990's
- Implemented and improved safety standards for oil and gas focused clients
- Developed largest Oil and Gas Insurance association in Colorado
- Chadron State College, B.S. in Finance and Marketing
- Member North Dakota Petroleum Council

ROBERT MAU
Chair, Principal, and Operator
Eagle Energy Partners I, LLC (EEPI)
2501 6th Street Southeast, Suite B, Minot, North Dakota 58701
Phone: 701.837.4780, E-Mail: eagleop@yahoo.com

Professional Summary

Mr. Mau, Chair, Principal, and Operator at EEPI, has 35+ years of experience as an operator and in all aspects of the upstream and midstream oil and gas business. He currently oversees all investments made by EEPI and is Chair of the Investment Committee. Under his leadership, hundreds of wells have been drilled, produced, and operated since 1991. The company has employed secondary recovery techniques since 2002, with an average of >5 times estimated production increases achieved and, in some cases, as high as 11 times.

Mr. Mau founded Eagle Operating Inc. in 1991, where he served as President. He founded Wolverine Drilling Co. 1996, the largest North Dakota-based drilling company at time of acquisition in 2004. He founded Eagle Well Service in the early 2000s, the largest North Dakota-based well service contractor (16 rigs) at time of acquisition in 2012. He was also the founder of MW Industries, a drilling rig-manufacturing company located in Kenmare, North Dakota.

Mr. Mau is a Former Chair of the North Dakota Petroleum Council and currently serves on its Board of Directors and Executive Committee since 1999. He was appointed by North Dakota Governor John Hoeven to serve on the Interstate Oil and Gas Compact Commission and the Oil and Gas Research Council. In 2007, he received the Pioneer Award from the Energy & Environmental Research Center's Plains CO₂ Reduction Partnership. In 2013, he was inducted into the North Dakota Petroleum Council Hall of Fame.



JOHN A. HARJU

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

701.777.5157 (phone), 701.777.5181 (fax), jharju@undeerc.org

Principal Areas of Expertise

Mr. Harju's principal areas of interest and expertise include carbon sequestration, enhanced oil recovery, unconventional oil and gas development, waste management, geochemistry, technology development, hydrology, and analytical chemistry, especially as applied to the upstream oil and gas industry.

Qualifications

B.S., Geology, University of North Dakota, 1986.

Postgraduate course work in Management, Economics, Marketing, Education, Climatology, Weathering and Soils, Geochemistry, Geochemical Modeling, Hydrogeochemistry, Hydrogeology, Contaminant Hydrogeology, Advanced Physical Hydrogeology, and Geostatistics.

Professional Experience

2002–Present: EERC, UND, Grand Forks, North Dakota.

July 2015–Present: Vice President for Strategic Partnerships. Mr. Harju leads efforts to build and grow dynamic working relationships with industry, government, and research entities globally in support of the EERC's mission to provide practical, pioneering solutions to the world's energy and environmental challenges. He represents the EERC regionally, nationally, and internationally in advancing its strategic energy and environmental initiatives focused on conventional and unconventional oil and gas development; zero-emission coal utilization; CO₂ capture and sequestration; energy and water sustainability; hydrogen and fuel cells; advanced air emission control technologies, emphasizing SO_x, NO_x, air toxics, fine particulate, and mercury control; renewable energy; wind energy; water management; flood prevention; global climate change mitigation; waste utilization; energy efficiency; and contaminant cleanup.

2003–June 2015: Associate Director for Research. Mr. Harju led the activities of a team of scientists and engineers, building industry–government–academic teams to carry out research, development, demonstration, and commercialization of energy and environmental technologies.

2002–2003: Senior Research Advisor. Mr. Harju's responsibilities included development, marketing, management, and dissemination of market-oriented research; development of programs focused on the environmental and health effects of power and natural resource production, contaminant cleanup, water management, and analytical techniques; publication and presentation of results; client interactions; and advisor to internal staff.

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

1999–2002: Vice President, Crystal Solutions, LLC, Laramie, Wyoming. Mr. Harju's firm was involved in commercial E&P produced water management, regulatory permitting and compliance, and environmental impact monitoring and analysis.

1997–2002: Gas Research Institute (GRI) (now Gas Technology Institute [GTI]), Chicago, Illinois.
2000–2002: Principal Scientist, Produced Water Management. Mr. Harju’s responsibilities included development and deployment of produced water management technologies and methodologies for cost-effective and environmentally responsible management of oil and gas produced water.

1998–2000: Program Team Leader, Soil, Water, and Waste. Mr. Harju’s responsibilities included project and program management related to the development of environmental technologies and informational products related to the North American oil and gas industry; formulation of RFPs, proposal review, and contract formulation; technology transfer activities; and staff and contractor supervision. Mr. Harju served as Manager of the Environmentally Acceptable Endpoints project, a multiyear programmatic effort focused on a rigorous determination of appropriate cleanup levels for hydrocarbons and other energy-derived contaminants in soils. He also led GRI/GTI involvement with numerous industry environmental consortia and organizations, including PERF, SPE, AGA, IPEC, and API.

1997–1998: Principal Technology Manager, Soil and Water Quality.
1997: Associate Technology Manager, Soil and Water Quality.

1988–1996: EERC, UND, Grand Forks, North Dakota.

1994–1996: Senior Research Manager, Oil and Gas Group. Mr. Harju’s responsibilities included the following:

- Program Manager for program to assess the environmental transport and fate of oil- and gas-derived contaminants, focused on mercury and sweetening and dehydration processes.
- Project Manager for field demonstration of innovative produced water treatment technology using freeze crystallization and evaporation at oil and gas industry site.
- Program Manager for environmental transport and fate assessment of MEA and its degradation compounds at Canadian sour gas-processing site.
- Program Manager for demonstration of unique design for oil and gas surface impoundments.
- Director, National Mine Land Reclamation Center for Western Region.
- Co-Principal Investigator on project exploring feasibility of underground coal gasification in southern Thailand.
- Consultant to International Atomic Energy Agency for program entitled “Solid Wastes and Disposal Methods Associated with Electricity Generation Fuel Chains.”

1994: Research Manager.

1990–1994: Hydrogeologist.

1989–1990: Research Specialist.

1988–1989: Laboratory Technician.

Professional Memberships

U.S. Department of Energy Unconventional Resources Technology Advisory Committee
Interstate Oil and Gas Compact Commission Energy Resources, Research, and Technology Committee
(former Chair) and Carbon Capture and Geological Storage Task Force
National Petroleum Council
Rocky Mountain Association of Geologists

Publications and Presentations

Has authored and coauthored more than 100 professional publications.



JOHN A. HAMLING

Principal Engineer, Oilfield Operations Group Lead
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 (phone), 701.777.5181 (fax), jhamling@undeerc.org

Principal Areas of Expertise

Mr. Hamling has over 10 years of combined experience in unconventional oil and gas development, enhanced oil recovery (EOR), and carbon capture, utilization, and storage (CCUS). He is a Principal Engineer at the EERC, where he integrates science and operations to catalyze pioneering solutions for geologic CO₂ utilization and the exploration, development, and production of oil and gas in unconventional plays.

Mr. Hamling's areas of expertise include development, implementation, and oversight of surface, near-surface, deep subsurface, and reservoir characterization and surveillance programs for geologic CO₂ storage and EOR. 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 leads the data analytics, operations, and reservoir surveillance groups at the EERC as well as 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. In addition, he is an Adjunct Lecturer in the Department of Petroleum Engineering at UND.

Qualifications

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

Professional Experience

2012–Present: Principal Engineer, Oilfield Operations Group Lead, EERC, UND. Mr. Hamling currently serves as PM, PI, and task lead for several multiyear, multimillion-dollar projects, where he leads a multidisciplinary team of scientists and engineers working to develop and implement monitoring, verification, and accounting (MVA) concepts for large-scale (>1 million tons per year) CO₂ storage and EOR operations. He also works with a multidisciplinary team in the development, design, and implementation of new approaches that benefit the economic exploration, development, and production of oil and gas.

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

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 CO₂ storage projects for the Plains CO₂ 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 CO₂ storage in geologic formations. Specific responsibilities included field operations design, deployment, and interpretation relating to oilfield technologies applicable to the CO₂ capture and storage (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 CO₂ Stored in Deep Geologic Formations – Version 3* and *Best Practices for Operating Carbon Storage Projects*.

Publications and Presentations

Has authored and coauthored numerous technical publications.



JAMES A. SORENSEN

Principal Geologist

Energy & Environmental Research Center (EERC), University of North Dakota (UND)

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Principal Areas of Expertise

Mr. Sorensen's principal areas of interest and expertise include tight oil resource assessment and development, carbon dioxide utilization and storage in geologic formations, and environmental issues associated with the oil and gas industry.

Education

B.S., Geology, University of North Dakota, 1991.

Postgraduate course work in Geology and Hydrogeology, 1993–1995.

Professional Experience

1999–Present: Principal Geologist, EERC, UND. Mr. Sorensen currently serves as manager and co-principal investigator for several research programs, including the Plains CO₂ Reduction (PCOR) Partnership, a multiyear program focused on developing strategies for reducing carbon dioxide emissions in nine states and four Canadian provinces. He has also conducted projects to develop an improved understanding of the Bakken petroleum system, including efforts to examine the potential to use carbon dioxide for enhanced oil recovery in the Bakken. Responsibilities include supervision of research personnel, preparing and executing work plans, budget preparation and management, writing technical reports and papers, presentation of work plans and results at conferences and client meetings, and proposal writing and presentation.

1997–1999: Program Manager, EERC, UND. Mr. Sorensen managed projects on topics that included produced water management, environmental fate of natural gas-processing chemicals, coalbed methane, and gas methane hydrates.

1993–1997: Geologist, EERC, UND. Mr. Sorensen conducted a variety of field-based hydrogeologic investigations throughout the United States and Canada. Activities were primarily focused on the subsurface mobility of constituents associated with 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 Memberships

Society of Petroleum Engineers

Publications and Presentations

Has coauthored nearly 200 publications.



WESLEY D. PECK

Principal Geologist, Geoscience Group Lead
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
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Principal Areas of Expertise

Mr. Peck's principal areas of interest and expertise include geographic information systems (GIS), cartography, information graphics, geology, and digital asset management. Mr. Peck currently oversees GIS activities for the Plains CO₂ Reduction (PCOR) Partnership. He is also the task leader for two regional characterization efforts within the PCOR Partnership.

Qualifications

M.S., Geology, University of North Dakota, 1992. Thesis: The Stratigraphy and Sedimentology of the Sentinel Butte Formation (Paleocene) in South-Central Williams County, North Dakota.
B.S., Earth Science, North Dakota State University, 1987.

Professional Experience

2015–Present: Principal Geologist, Geoscience Group Lead, EERC, UND. Mr. Peck leads a staff of geoscientists involved in subsurface resource development with an emphasis on the Williston and Powder River Basins. He also serves as task lead and principal investigator of the regional geologic characterization component of the Plains CO₂ Reduction Partnership (PCOR) Partnership Program, which focuses on carbon dioxide storage in central North America.

2011–2015: Research Manager, EERC, UND. Mr. Peck's responsibilities include overseeing a staff of geologists and GIS specialists involved with oil and gas research activities in the Williston Basin as well as regional geologic characterization activities associated with the PCOR Partnership.

1991–2011: Research Scientist, EERC, UND. Mr. Peck's responsibilities included overseeing major GIS activities at the EERC, serving as task leader for the regional characterization component of the PCOR Partnership, as well as report and proposal writing.

1989–1991: Graduate Research Assistant, EERC, UND. Mr. Peck's responsibilities included acquisition and management of geologic data related to Cretaceous and Tertiary geology of the Williston Basin. Mr. Peck also assisted in the collection of Cretaceous and Tertiary fossils and stratigraphic information in western North Dakota and eastern Montana.

Publications and Presentations

Has authored and coauthored several professional publications.



LAWRENCE J. PEKOT

Principal Engineer, Reservoir Engineering Group Lead
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5376 (phone), 701.777.5181 (fax), lpekot@undeerc.org

Principal Areas of Expertise

Mr. Pekot's principal areas of interest and expertise include unconventional reservoir engineering, including CO₂ storage and enhanced oil recovery (EOR), coalbed methane (CBM), enhanced coalbed methane (ECBM), shale gas, natural gas storage, and hydraulic fracturing; integrated project management; field studies; and reserve evaluations.

Qualifications

B.S., Civil Engineering, Pennsylvania State University, 1978.
B.S., Geological Science, Pennsylvania State University, 1978.

Professional Experience

September 2015–Present: Principal Engineer, Reservoir Engineering Group Lead, EERC, UND. Mr. Pekot's responsibilities include:

- Leading reservoir engineering evaluations for CO₂ EOR, CO₂ storage, and unconventional hydrocarbon recovery projects.
- Leading a group of reservoir engineers on multiphase flow, geomechanical, and thermal simulations.

2013–2015: International Project Manager, Schlumberger Carbon Services, Denver, Colorado. Mr. Pekot's responsibilities included:

- Management of CO₂ evaluation projects outside of the United States, Australia, and Canada.
- Supervision of site selection studies, simulation, appraisal planning, risk analysis, injection testing and monitoring technologies, regulatory compliance, cost estimation, and reporting.
- Supervision and mentoring of junior staff.

2008–2013: Technical Manager for Europe/Africa, Schlumberger Carbon Services, Paris, France. Mr. Pekot's responsibilities included:

- Technical oversight of carbon storage evaluation projects and opportunities in Europe and Africa, including work in the United Kingdom, Ireland, Spain, Italy, Poland, Romania, Bulgaria, Libya, South Africa, and Australia.
- Coordination of projects and resources between Schlumberger's Consulting and Carbon Services businesses.
- Strategic, technical, and business development assistance for unconventional reservoir problems, including natural gas storage, geothermal, CBM, and EOR.
- Management of corporate special projects and resource evaluations.
- Project peer reviews for other business units.
- Introduction of corporate project management procedures to Carbon Services.
- Junior staff mentoring and introduction to the corporate technical advancement system.

2004–2007: Principal Consultant, Schlumberger Data and Consulting Services, Pittsburgh, Pennsylvania. Mr. Pekot's responsibilities included:

- Engineering studies for tight gas, gas storage, shale, and CBM properties in the United States and Canada.
- Reserve reporting evaluations for conventional, CBM, and CO₂ flood properties.
- EOR CO₂ flood evaluations of Michigan Basin pinnacle reef reservoirs.
- Saline formation test site modeling for CO₂ storage in Ohio and Texas; one done for Schlumberger R&D.
- Initial evaluation and carbon sequestration site prescreening for carbon storage for the New York Clean Coal Power Initiative.
- Two CO₂ sequestration site screening evaluations for U.S. electric utility clients.
- A Pacific Basin overview study of CO₂ EOR and ECBM potential for a Japanese client.

1995–2003: Vice President, Advanced Resources International, Inc., Washington, D.C. Mr. Pekot's responsibilities included:

- Development, maintenance, and marketing of the firm's technical software programs, COMET for reservoir simulation and METEOR for analytic type curve evaluations.
- Serving as a reservoir engineering advisor for the U.S. Federal Energy Regulatory Commission.
- Performing or supervising well testing and numerical simulation evaluations of numerous gas, oil, gas storage, CBM, ECBM, and other unconventional reservoirs, including projects in Australia, Canada, China, Czech Republic, India, Poland, South Africa, and the United States.
- Exploration, appraisal, and development planning.
- ECBM simulation.
- Evaluation of geologic storage options for greenhouse gas sequestration potential.
- Shale gas well performance evaluation.
- Estimated reserves for merger and acquisition economic evaluations.
- Field demonstration of advanced simulation technologies for gas storage wells.
- Well testing and evaluation methodologies for gas storage remediation candidate selection.
- Supervision of the reservoir simulation and design of the development plan for the first gas storage reservoir in the People's Republic of China.

1991–1995: Principal Consultant, Scandpower A/S (now known as SPT Group of Schlumberger), Oslo, Norway. Mr. Pekot's responsibilities included:

- Administrative supervision of a team of four engineering consultants.
- Project management.
- Technical assistance to junior staff.
- Software marketing and technical support.
- Consulting for
 - PEMEX (Mexico).
 - Norsk Hydro, where he used state-of-the-art engineering techniques and simulation software (ECLIPSE) to help optimize the \$2 billion oil development plan for the Troll Field in the North Sea, edited the reservoir engineering proposal for a \$150 million field expansion, and prepared and delivered numerous presentations to license holders and government authorities.
 - Saga Petroleum, where he developed an engineering and geologic database for the unitized Snorre Field to be used in field ownership redetermination and conducted a reservoir simulation study to determine optimum recovery techniques for the Gullfaks South reservoir.

1978–1991: Senior Petroleum Engineer, Phillips Petroleum Company, Stavanger, Norway, and Houston, Texas. Mr. Pekot's responsibilities included the following:

- Senior Joint Venture Engineer for Gulf of Mexico properties (3 years), including profit and loss accountability for a \$20 million capital and expense budget; economic evaluation for \$60 million development of a new gas field; technical and economic evaluations for rehabilitation of a large, old oil field, where production doubled and reserves increased 50%; evaluation of deep-water exploration leases; technical and economic analysis for drilling, well workovers, process equipment upgrades, platform construction, and rehabilitation, writing project justifications and obtaining approvals; and Reserves evaluations.
- Senior Engineer (4 years), including supervision of a team of engineers for numerical simulation of North Sea oil and gas fields; setting group objectives and scheduling and delegating assignments; junior staff performance evaluation and career counseling; drilling and workover proposal justifications; economic analysis; reservoir management plan maintenance and updates; evaluation of oil and gas reserves under depletion and various gas and water injection development proposals; and temporary section leader, supervising ten engineers.
- Associate Production Geologist (2 years), including wellsite geology; correlating geological and geophysical data and creating maps and cross sections, geological field study for the development of the Tommeliten gas fields, coauthoring and editing the geologic field study for the \$1 billion Ekofisk Field waterflood project, and serving on the project team that developed a North Sea geological database.
- Staff Reservoir Engineer (3 years), including wellsite testing and analysis of new gas production wells, well test analysis and selection of new drilling locations, evaluation of field production problems, technical report writing, corrective action recommendations, and unitized field operations; found new reserves located in formations previously considered uneconomical.
- General land-based production (1 year), including EOR projects, drilling, and workover operations, and land surveying and piping design.

Professional Affiliations

Member, Society of Petroleum Engineers Distinguished Lecture Review Committee, 2006–2011
 Technical Reviewer, *International Journal of Coal Geology and International Journal of Greenhouse Gas Control*
 Adjunct lecturer, University of North Dakota Dept. of Petroleum Engineering

Publications and Presentations

Has authored or coauthored numerous publications.

APPENDIX D

REFERENCES

REFERENCES

- Burke, R., 2005, Unitized pools reservoir characteristics: North Dakota Geological Survey Geological Investigations 11a.
- Hawthorne, S.B., Miller, D.J., Jin, L., and Gorecki, C.D., 2016, Rapid and simple capillary-rise/vanishing interfacial tension method to determine crude oil minimum miscibility pressure—pure and mixed CO₂, methane, and ethane: *Energy & Fuels*, <http://pubs.acs.org/doi/abs/10.1021/acs.energyfuels.6b01151>.
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- Voegele, E., 2017, EERC, Red Trail Energy continue to reduce CO₂ emissions: *Ethanol Producer Magazine*, December 29, www.ethanolproducer.com/articles/14924/eerc-red-trail-energy-continue-to-reduce-co2-emissions (accessed 2018).