Energy & Environmental Research Center
15 North 23rd Street, Stop 9018 • Grand Forks, ND 58202-9018 • P. 701.777.5000 • F. 701.777.5181
www.undeerc.org

November 1, 2024

Mr. Reice Haase
Deputy Executive Director
North Dakota Industrial Commission
ATTN: Oil and Gas Research Program
State Capitol – 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

Dear Mr. Haase:

Subject: EERC Proposal No. 2025-0054 Entitled "Breaking New Ground in Flaring Reduction" in Response to the North Dakota Industrial Commission Oil and Gas Research Program Clean Natural Gas Capture and Emissions Reduction Program

The Energy & Environmental Research Center (EERC) is pleased to propose a project that will capture natural gas which would have otherwise been flared and will implement advanced technology on oil and gas wellsites. Steffes LLC and Advanced Flow Solutions Inc. are providing project cost share. These organizations provide manufacturing and servicing support for the flare reduction technology (Polar Bear™) that is under joint development with the EERC. The technology targets most of the remaining flared gas in North Dakota, designed to accomplish near-zero emissions.

The 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) 777-5201 or by email at dschmidt@undeerc.org.

Sincerely,

DocuSigned by:
Darren Schmidt
DBBB990DF8C34D8...

Darren D. Schmidt
Assistant Director for Energy, Oil, and Gas

Approved by:

DocuSigned by:
Tami Votava
E7468BBB3DE440E...

for

Charles D. Gorecki, CEO
Energy & Environmental Research Center

DDS/rlo
Attachments

c/att: Erin Stieg, NDIC OGRP

Oil and Gas Research Program:

Clean Natural Gas Capture and Emissions Reduction Program

North Dakota Industrial Commission

Application

Project Title: Breaking New Ground in Flaring Reduction

Applicant: University of North Dakota Energy & Environmental Research Center

Principal Investigator: Darren D. Schmidt

Date of Application: November 1, 2024

Amount of Request: $2,566,341

Total Amount of Proposed Project: $5,132,682

Duration of Project: 12 months

Point of Contact (POC): Darren D. Schmidt

POC Telephone: (701) 777-5201

POC E-Mail Address: dschmidt@undeerc.org

POC Address: 15 North 23rd Street, Stop 9018, Grand Forks, ND 58202-9018

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ABSTRACT

Objective: The objective is to deploy 30 gas capture units on well pad facilities in North Dakota to reduce or eliminate gas flaring. The purpose is to achieve near-zero wellsite emissions and accelerate the adoption of state-of-the-art technology. An adequate sample size is proposed to assess gas capture performance for multiple operators including variations of wellsite facilities. Advancements include oil-free natural gas compression and new methods for facility integration that boost economics, simplify installation, and lower operational costs compared to conventional vapor recovery.

Expected Results: A summary of work performed, description of site locations, installation photos, project costs, and rates and volumes of gas captured will be reported to the Oil and Gas Research Program (OGRP) on an interim basis. Results will reduce the cost and risk for owners and operators to capture gas that would otherwise be flared, reduce emissions, accelerate commercial deployment of new technology, and continue to deliver impacts beyond the term of the project.

Duration: 1 year (January 1, 2025 – December 31, 2025).

Total Cost: The total value of the project is $5,132,682. The OGRP request is for 50%, $2,566,341. Cost-share commitments are provided from Advanced Flow Solutions Inc. and Steffes LLC at $1,824,500 and $741,841, respectively.

Participants: Energy & Environmental Research Center, Advanced Flow Solutions Inc., Steffes LLC, and selected operators.

PROJECT DESCRIPTION

Polar Bear™ is a technology catalyzed and patented by the Energy & Environmental Research Center (EERC) designed to capture most of the remaining flared gas in North Dakota. Iconically named to symbolize robustness, adaptiveness, and environmental sensitivity, successful implementation can lower the carbon footprint of oil and gas production and is aligned with the industry's priorities for reducing methane emissions and achieving compliance with new U.S. Environmental Protection Agency (EPA) regulations. The EERC is partnered with Steffes LLC, a respected local manufacturer, and Advanced Flow Solutions Inc. to deploy the first Polar Bear™ systems within the Bakken. The project will capture flared gas and demonstrate that economically challenging circumstances for gas flaring can be overcome, resulting in cost-effective solutions.

Objectives: The objective is to deploy 30 gas capture units on well pad facilities in North Dakota to reduce or eliminate gas flaring. The purpose is to achieve near-zero wellsite emissions and accelerate the adoption of state-of-the-art technology. An adequate sample size is proposed to assess gas capture performance for multiple operators including variations of wellsite facilities. Advancements include oil-free natural gas compression and new methods for facility integration that boost economics, simplify installation, and lower operational costs compared to conventional vapor recovery.

Methodology: The EERC will lead the contract with the North Dakota Industrial Commission (NDIC) and provide interim reporting to the Oil and Gas Research Program (OGRP) in accordance with the Oil and Gas Research Council (OGRC) policies of the Clean Natural Gas Capture and Emissions Reduction Program. The work will include coordination with operators in North Dakota to host Polar Bear™ gas capture units; procurement of the units from Steffes LLC; and coordination with service providers and operators for installation, commissioning, and operation. The gas capture units will be fitted with gas flowmeters and the capability to record volume and rates of gas captured. The EERC will report on the gas captured and locations of installed equipment, summarize work performed, provide equipment

photos, and report project costs and matching cost share. The operators will take ownership of the gas capture units upon delivery and operate beyond the project term.

The project is designed to provide a meaningful implementation pilot to cover a diversity of wellsites and facility types and a variety of operators to demonstrate gas capture for most of North Dakota's remaining flared gas, which is economically challenging to recover. The pilot will help reduce the cost and risk for operators looking to adopt new technology and to accelerate commercial deployment and manufacturing. Gas capture units can be applied to heater treaters, separation equipment, tank vapor recovery, liquids production, and utilization for fuel on-site. Specifically designed to capture gas volumes from an average producing well, units have application to single-well leasehold facilities, comingled bulk and test facilities, and unique layouts of separation equipment. Presently a capacity of 50 Mcfd is available per unit; however, units can be installed in parallel to achieve higher capacity. Given the diversity of facilities in North Dakota and present manufacturing capacity, deployment of 30 units appears to cover the diversity of applications and operators with some level of repeated demonstration. Priority will include capture of gas from high-pressure flares and recovery of tank vapors, with preference to operators expressing support for the project.

Anticipated Results: Project results are anticipated to further the purpose of the Clean Natural Gas Capture and Emissions Reduction Program that was authorized in 2023 by Senate Bill 2089. The program is an incentive payment for projects that capture or utilize natural gas which would otherwise be flared and replaces a prior tax incentive for similar projects. The proposed Polar Bear™ gas capture technology is an equipment skid that is designed to capture and compress 50 Mcfd of low-pressure gas. Innovations of the technology include facility integration, hydrocarbon recovery, and eliminating compressor oil maintenance. During the 1-year project, 30 units will be deployed, commissioned, and operated to quantify and report the rates and volumes of captured gas. The Polar Bear™ technology specifically addresses the challenges associated with the remaining volume of flared gas in North Dakota. To reduce

flaring to near-zero, gas must be captured at a large number of well locations that flare small amounts of gas in which the economics are independently challenging for the operator and mineral owners. The proposed project is designed to implement technology in a field pilot for the purpose of accelerating adoption by the industry. The goal is to tackle the present challenges associated with the remaining gas flaring in North Dakota, which will result in a cleaner barrel of oil, commensurate economic benefits, industry performance, and additional tax revenue.

Facilities, Resources, and Techniques to Be Used and Their Availability and Capability: The project will be conducted in the field at wellsite locations provided by North Dakota operators. Letters indicating interest on behalf of operators are included in Appendix A.

Resources for the project are provided by the EERC, Steffes LLC, and Advanced Flow Solutions Inc. in collaboration with participating oil and gas operators in North Dakota to host the technology at various wellsites. The project partners have available personnel to dedicate to the project who are experienced engineers and technicians qualified in oil and gas facility engineering, servicing, and manufacturing. Steffes is the supplier of the equipment skids. Advanced stocking of inventory will allow the project team to meet accelerated delivery of units to the field. Equipment preparation and delivery can occur within the first quarter of the project for the first skids.

Environmental and Economic Impacts: According to the most recent director's cut,[1] which includes the Department of Mineral Resources monthly production reporting, gas captured in July 2024 is 3,245,517 Mcfd at a rate of 94% and 217,343 Mcfd of gas was flared at a rate of 6%. The commercial value of the flared gas, assuming a price of $5.00 per Mcf, which includes both dry gas and natural gas liquids (NGLs), is equivalent to $33.4 million. The gas tax rate provided by the North Dakota State Tax

[1] www.dmr.nd.gov/dmr/sites/www/files/documents/Oil-and-Gas/DirectorsCut/October%202024%20Directors%20Cut.pdf (accessed Oct 2024).

Commissioner for the fiscal year July 1, 2024, to June 30, 2025, is $0.0646 per Mcf.[2] Therefore, the estimated uncollected tax value for the July flared volume is approximately $435,000.

EPA published rules to significantly reduce greenhouse gas emissions from the oil and gas industry on March 8, 2024, focused on methane emissions. The rules in the Federal Register, 40 Code of Federal Regulations (CFR) part 60 subpart OOOOb, set standards for new, modified, and reconstructed sources after December 6, 2022, and subpart OOOOc applies to existing sources. EPA's methane regulations include many aspects that significantly impact oil and gas operations as summarized:

- Super Emitter Program – EPA's program to certify third parties to report methane emissions exceeding 100 kg/hr.
- Elimination of routine flaring – The flaring of associated gas from wells in the absence of temporary or emergency circumstances necessitating such flaring.
- Methane fee – $900/ton 2024, $1200/ton 2025, $1500/ton 2026.
- Advanced leak detection and monitoring techniques.
- Liquid unloading requirements – submission of best management plans and reporting.
- Process controller and pumps – zero-emission standard for pneumatic controllers.
- Storage tanks – tank battery emissions subject to federal standards versus individual tank emissions at 6 tpy of volatile organic compounds (VOCs) and 20 tpy of methane.
- Plugging and abandoned well requirements – Required well closure plans, monitoring of fugitive emissions, and optical gas-imaging surveys.

[2] www.tax.nd.gov/sites/www/files/documents/newsletters/oil-gas/gat-tax-rate-notice.pdf (accessed Oct 2024).

EPA methane rules mandate over a 2-year period a phaseout of routine flaring from new oil and gas wells. Some flexibility is provided for existing wells that may not have cost-effective alternatives to flaring. States have a 2-year period to submit plans to EPA regarding rules for existing wells.[3]

Why the Project Is Needed: North Dakota's Department of Mineral Resources in collaboration with industry set policies for gas capture which began October 1, 2014.[4] The policy goals include reducing the flared volume of gas, reducing the number of wells flaring, and reducing the duration of flaring from wells. Figure 1 provides an annual history of gas flaring from 2010 to 2023 and performance with respect to policy goals. Today, the industry exceeds the 91% gas capture policy target and, in 2023, achieved 95% gas capture for the year. What contributes to the gas capture success is the industry's investment in midstream infrastructure enabling more gas to be gathered via pipeline and processed.

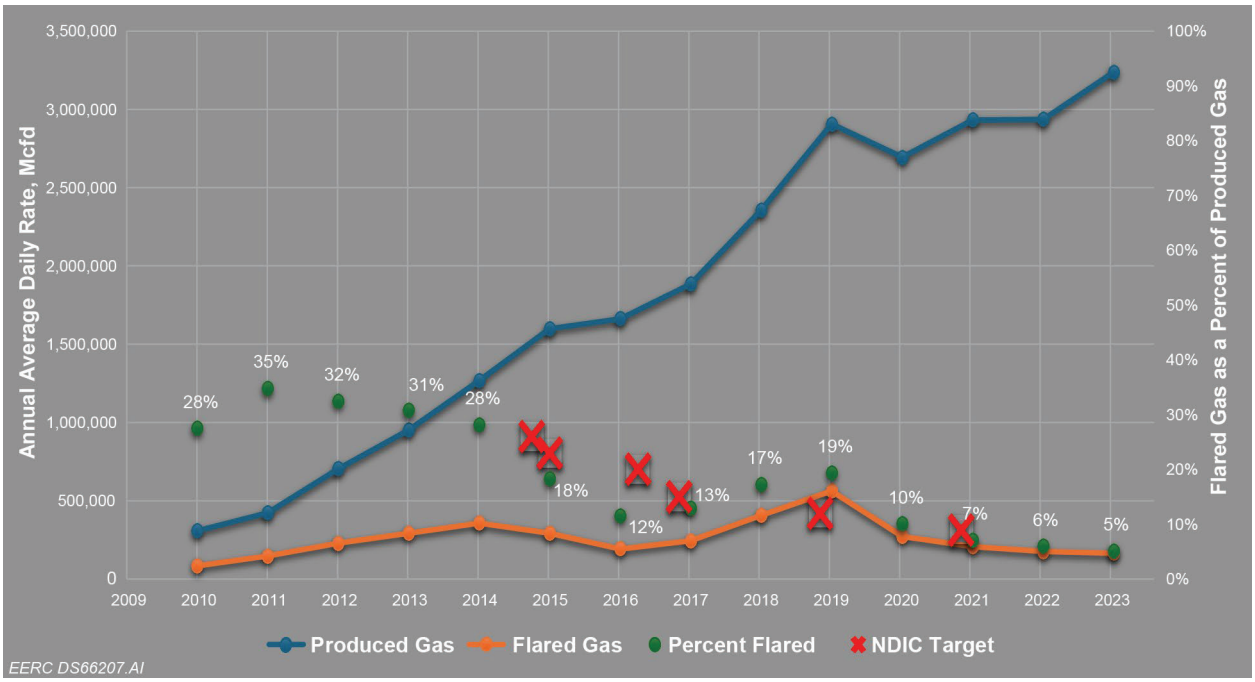

Figure 1. North Dakota's history of gas production and flaring with respect to policy goals.[5]

[3] www.epa.gov/system/files/documents/2023-12/epas-final-rule-for-oil-and-gas-operations.-overview-fact-sheet.pdf (accessed Oct 2024).
[4] www.dmr.nd.gov/oilgas/GuidancePolicyNorthDakotaIndustrialCommissionorder24665.pdf (accessed Oct 2024).
[5] Production data from the North Dakota Department of Mineral Resources (accessed Oct 2024).

Since 2019, industry has also shifted drilling plans away from areas that do not have gas takeaway capacity. These actions along with innovations such as data centers, mobile skids to capture NGLs, utilization of compressed natural gas (CNG), and installation of vapor recovery units (VRUs) have all contributed to decreasing the flaring rate.

Although the state's policies to reduce flaring have largely been achieved, Governor Burgum set a goal to keep North Dakota's energy production globally competitive by becoming carbon-neutral by 2030.[6] Industry objectives are to achieve near-zero emissions, and federal compliance continues to become more restrictive. This project is needed to further reduce gas flaring in North Dakota and maintain a competitive industry within the state.

North Dakota's production is primarily light sweet crude oil from the Bakken and Three Forks Formations. The Bakken petroleum system uniquely produces a rich gas that is associated with oil production. Associated gas, on a revenue basis per well, is a much lower revenue stream than the oil produced per well. Despite the lower monetary value, North Dakota is presently the tenth largest producer of gas in the country. Additionally, the gas-to-oil ratio in the Bakken is increasing and has nearly doubled since 2016.[7] Unlike dry gas production, associated gas does not always get the advanced build-out investment and instead requires more time as oil properties develop across the play. The project is needed to help overcome challenges associated with limitations in gas takeaway capacity.

Where conventional technology has enabled industry to exceed North Dakota's gas capture policies, eliminating the remaining 5% of gas flaring is exponentially more difficult and requires new approaches. The remaining volume of flared gas is at a significant economic disadvantage. These gas volumes are geographically dispersed across many wells producing much less oil than the initial production, typically under 100 bpd. This flared gas volume in aggregate is primarily sourced from wells

[6] https://news.prairiepublic.org/local-news/2021-05-12/burgum-nd-carbon-neutral-by-2030 (accessed Oct 2024).
[7] https://northdakotapipelines.com/wp-content/uploads/2024/09/justin-kringstad-ndpc-9-19-24.pdf (accessed Oct 2024).

that also flare less than 10% of their produced volume.[8] Therefore, technology must be able to capture intermittent small volumes of gas and be cost-effective based on the limited gas volume. One benefit is that most of these wells are connected to a gathering line versus completely stranded from any gas gathering. Wellhead pressure typically declines after initial production, and in many cases, the gas production can be interrupted by intermittent spikes in pipeline pressure due to neighboring production. Polar Bear™ is designed to economically capture small volumes of gas, reprocess within the facility, and maintain gas pressures to keep gas in the pipe. The process enables low-pressure gas at the wellhead, from heater-treaters, or tank vapors to be used as fuel on-site, to be sold as hydrocarbon liquid, or boosted to gas sales. The process is described in eight patents issued by the U.S. Patent and Trade Office between 2022 and 2024.[9] The project is needed to accelerate the implementation of new technology that can address the challenges associated with the remaining gas flaring in North Dakota.

STANDARDS OF SUCCESS

Success will be measured in accordance with the reporting requirements of the Clean Natural Gas Capture and Emissions Reduction Program. Requirements include a comprehensive report to the Commission including a summary of the work performed, photos of installed equipment, documentation of project costs and matching cost share, locations of installed equipment, and rates and volumes of gas captured. The proposal includes installing 30 units at oil and gas facilities in North Dakota. A unit is depicted in Figure 2 which includes a compressor rated at 50 Mcfd at a pressure differential of 70 psi. A successful project will have completed installation and operation of 30 units with commensurate reporting of performance. It is anticipated the public and private sector would utilize the results to understand how the technology can be applied and replicated to tackle challenges with gas flaring and reduce emissions.

[8] Presentation at the Western Dakota Energy Association Annual Meeting, Minot, ND, Oct 9, 2024.
[9] U.S. Patents 11,505,750 B1, 11,542,439 B1, 11,697,773 B1, 11,725,154 B2, 11,814,591 B1, 11,884,887 B1, 12,024,682 B2, 12,065,619 B2.

Figure 2. Polar Bear™ unit.

BACKGROUND/QUALIFICATIONS

The EERC is a nonprofit branch of the University of North Dakota. Mr. Darren Schmidt, Assistant Director for Energy, Oil, and Gas, will serve as Project Manager. Mr. Schmidt is a registered professional engineer in mechanical and petroleum engineering and the author of ten patents regarding gas utilization technologies. Other key EERC personnel include Dr. Youcef Khetib, a Senior Petroleum Engineer, and Mr. Bradley Stevens, a Principal Research Engineer in Civil Engineering. Dr. Khetib holds a Ph.D. degree in Petroleum Engineering from UND. Mr. Stevens is a registered professional engineer in Civil Engineering in North Dakota and Minnesota. Both Dr. Khetib and Mr. Stevens have been integral in the design, engineering, and testing of the Polar Bear™ technology. Resumes of key personnel are provided in Appendix B.

Steffes LLC is a lean-operating original equipment manufacturer headquartered in Dickinson, North Dakota, with additional manufacturing facilities in Grand Forks, North Dakota; Shelby, North Carolina; and customer support facilities in Midland, Texas; Casper, Wyoming; and Oklahoma City, Oklahoma. Steffes is specialized in steel fabrication and electrical services for a variety of diverse industries, including oil and gas, contract manufacturing, and electric thermal storage. Steffes has been in business for more than 70 years and has achieved notable innovations in the oil and gas industry such

as the Steffes variable orifice flare, which achieves 99% destruction efficiency and accommodates the production decline associated with Bakken wells while maintaining environmental performance.

Advanced Flow Solutions Inc. is one of 50 business units under IDEX Corporation, encompassing 9000 employees. Specializing in compression and pumping solutions, the organization's 250 employees provide the resources for a century-old leader in industrial compression. Manufacturing expertise includes precision machining, welding, assembly, testing, and material handling. They specialize in creating high-quality components and systems that are used in a variety of applications, including fuel and gas handling, chemical processing, and other industrial sectors.

MANAGEMENT

The EERC manages over 200 contracts a year, with a total of over 1300 clients in 53 countries. Project management software and accounting systems are in place to ensure that projects are managed within budget, schedule, and scope. Mr. Schmidt will oversee the entire program, with assistance in management of program activities by Dr. Khetib and Mr. Stevens. Interim reports will be submitted to NDIC in accordance with the program requirements.

TIMETABLE

A project term of 1 year is proposed, starting January 1, 2025. The EERC will coordinate with host site operators and proceed with equipment orders within the first quarter of the project. Equipment deliveries will occur over the course of the project, with the majority of completion expected by June 30, 2025. Commissioning and operation will occur over the second half of the project, with completion by December 31, 2025.

BUDGET

The total estimated cost for the proposed effort is $5,132,682. $2,566,341 is requested from OGRP. Cost-share commitments are provided from Advanced Flow Solutions Inc. and Steffes LLC at $1,824,500 and $741,841, respectively. The in-kind cost share includes the engineering, development, and testing of

the Polar Bear™ technology during the legislative biennium (7/1/2023–6/30/2025) and through the end of the project term. Letters of commitment can be found in Appendix C. The budget breakdown is provided in Table 1. Budget notes can be found in Appendix D.

Table 1. Budget Breakdown

Project Associated Expense	NDIC Share (Cash)	Industry Share (In-kind)	Total Project
Labor	$421,720	$0	$421,720
Travel	$87,062	$0	$87,062
Equipment > $5000	$1,500,000	$0	$1,500,000
Supplies	$30,000	$0	$30,000
Subcontractor – TBD Site Support	$80,000	$0	$80,000
Communications	$78	$0	$78
Printing & Duplicating	$100	$0	$100
Laboratory Fees & Services			
Document Production Service	$5,068	$0	$5,068
Technical Software Fee	$17,543	$0	$17,543
Engineering Services Fee	$1,597	$0	$1,597
Field Safety Fee	$61,594	$0	$61,594
Outside Lab – Gas Sampling	$20,000	$0	$20,000
Total Direct Costs	$2,224,762	$0	$2,224,762
Facilities & Administration	$341,579	$0	$341,579
Total Cash Requested	**$2,566,341**	**$0**	**$2,566,341**
In-Kind Cost Share			
Advanced Flow Solutions	$0	$1,824,500	$1,824,500
Steffes	$0	$741,841	$741,841
Total In-Kind Cost Share	**$0**	**$2,566,341**	**$2,566,341**
Total Project Costs	**$2,566,341**	**$2,566,341**	**$5,132,682**

TAX LIABILITY

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

CONFIDENTIAL INFORMATION AND PATENTS/RIGHTS TO TECHNICAL DATA

This proposal has no confidential information. There are existing patents; no patentable technologies are expected to be created with respect to the project funding.

STATUS OF ONGOING PROJECTS

The EERC is currently engaged in five OGRP-funded projects. These ongoing projects, listed in Appendix E, are current on all deliverables.

APPENDIX A

OPERATOR LETTERS OF SUPPORT

Hess Corporation
1501 McKinney Street
Houston, TX 77010

October 16, 2024

Mr. Darren Schmidt
Assistant Director for Energy, Oil and Gas
Energy and Environmental Research Center
15 N. 23rd St.
Grand Forks, ND 58202-9018

Subject: Proposal Entitled: "Breaking New Ground in Flaring Reduction"

Dear Mr. Schmidt:

Hess Corporation is aware that the Energy and Environmental Research Center (EERC) is applying for funding from the Clean Natural Gas Capture and Emissions Reduction Program administered through the North Dakota Industrial Commission's Oil and Gas Research Program. Hess would be interested in participating by providing a host site for Polar Bear™ technology as part of the project.

Sincerely,

Brent Lohnes
General Manager – North Dakota

Petro-Hunt, L.L.C.

P.O. Box 935
Bismarck, ND 58502
Phone (701) 255-5666 Fax (701) 258-1562
e-mail - jherman@petrohunt.com

October 24, 2024

Mr. Darren Schmidt
Assistant Director for Energy, Oil and Gas
Energy and Environmental Research Center
15 N. 23rd St.
Grand Forks, ND 58202-9018

Subject: Proposal Entitled: "Breaking New Ground in Flaring Reduction"

Dear Mr. Schmidt:

Petro Hunt is interested in supporting well-site application of the Polar Bear™ gas capture technology as part of the Energy and Environmental Research Center's (EERC) proposal to the Clean Natural Gas Capture and Emissions Reduction Program. This work will help advance gas capture in North Dakota and offer the industry additional options for environmental compliance.

Sincerely,

Representative Name
Jeff Herman
Title – Region Manager

APPENDIX B

RESUMES OF KEY PERSONNEL

DARREN D. SCHMIDT
Assistant Director for Energy, Oil, and Gas
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5201, dschmidt@undeerc.org

Education and Training

B.S., Mechanical Engineering, West Virginia University, 1994.
Registered Professional Engineer (Mechanical and Petroleum).

Research and Professional Experience

February 2021–Present: Assistant Director for Energy, Oil, and Gas, EERC, UND.

- Leads a team focused on research, development, and commercialization related to efficient and clean fossil fuel production, utilization, carbon management, and alternative fuels and renewable energy.

Principal areas of interest and expertise include oil and gas facilities, production, injection, well stimulation, enhanced recovery, power generation, and renewable technologies.

2016–January 2021: Principal Engineer, Research and Technology, Equinor, Williston, North Dakota.

- Provided leadership for Equinor's research portfolio in Bakken/Williston Basin, with focus on low carbon.
- Developed project focused on reducing flaring in which patent application was filed.
- Earlier work included leading team to develop CO_2 used in well stimulations.
- Through Equinor's involvement with North Dakota Oil and Gas Research Program, research was completed to address requirements surrounding crude oil vapor pressure.
- Worked closely with Equinor's Williston office regional manager to support operations, including serving as regulatory liaison for emergency response team.

2013–2016: Completions Engineer, Statoil Completions, Williston, North Dakota.

- Served as completions engineer for Williams County, with strong focus on safe operations.
- Led successful program in 2015 to use 10% produced water in Statoil hydraulic fracturing operations.
- Oversaw hydraulic fracture designs, quality of operations, implementing new procedures, enforcing standard operating procedures, and approving fieldwork.
- Mentored interns and completions-related research projects to improve performance.

2012–2013: Technical Advisor, Weatherford Fracturing Technologies, Williston, North Dakota.

- Provided leadership to Williston district to ensure job quality, safety, personnel management, education, and training.
- Supported revenue; provided intelligence; conducted marketing; provided urgent response to customers, field services, and client-based technical assistance; and ensured quality reporting.
- Provided technical guidance to district stimulation fluids laboratory.

2008–2012: Senior Research Advisor, EERC, UND.

- Oversaw procurement and execution of research projects related to Bakken Formation in Williston Basin. Projects included utilization of associated gas in drilling operations, laboratory investigation of conductivity associated with proppants, fracturing fluids, and rock formations, enhanced production from coal bed methane, geologic storage of CO_2, and oil-field drilling, production, and workover operations.
- Served as advisor to distributed biomass gasification development and contributed to organization's revenue through research proposals, publications, and intellectual property.

1998–2008: Research Manager, EERC, UND.

- Secured research contracts, managed projects, and performed engineering tasks in the areas of cofiring and biomass power systems, including combustion, fluidized-bed, gasification, microturbine, and internal combustion engine generators; energy efficiency; ground-source heat pumps; hydrogen production from biomass; and researching the behavior of biomass in combustion systems relative to ash fouling and trace elements.

1994–1998: Mechanical Engineer, Research Triangle Institute (RTI), Research Triangle Park, North Carolina.

- Served as project leader for $3M Cooperative Agreement with U.S. Environmental Protection Agency (EPA) to demonstrate electricity production using 1-MW wood gasification technology.
- Significant experience included permit, design, installation, operations, and reporting.
- Other activities included support of marketing activities and coauthoring publications.

Summer 1993: Internship, EERC, UND, Grand Forks, ND.

- Supported combustion and coal ash studies.

Summer 1992: Internship, Foster Wheeler Development Corporation, Livingston, New Jersey.

- Supported gasification research and development.

Professional Activities

Appointed Member, North Dakota Oil and Gas Research Council
Cochair, North Dakota Petroleum Council Technology Solutions Group
Section Chair, Williston Basin Society of Petroleum Engineers

Publications

Has authored or coauthored over 80 peer-reviewed and other professional publications.

Patents

Method and Apparatus for Supply of Low-Btu Gas to an Engine Generator. U.S. Patent 8,460,413, June 11, 2013.

Application of Microturbines to Control Emissions from Associated Gas. U.S. Patent 8,418,457, April 16, 2013.

Hydrocarbon Gas Recovery Methods. U.K. Application No. 2009516.2, filed June 22, 2020.

DR. YOUCEF KHETIB
Senior Petroleum Engineer
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5268, ykhetib@undeerc.org

Education and Training

Ph.D., Petroleum Engineering, University of North Dakota, 2022.
M.Eng., Petroleum Engineering, University of Boumerdes, Algeria, 2013.
B.Eng., Petroleum Engineering, University of Boumerdes, Algeria, 2010.
Software: OLGA®, Pipesim®, OFM®, ECLIPSE®, PETREL®, Multiflash®, Aspen HYSYS®, DrillingInfo® (Everus), Salesforce®, and Medallia®.
Languages: Arabic, French, English, and German.

Research and Professional Experience

January 2023–Present: Senior Petroleum Engineer, EERC, UND.

- Evaluates oil production from unconventional wells using transient multiphase flow analysis.
- Conducts flow assurance and facility feasibility.
- Conducts modeling with advanced knowledge of software platforms specific to multiphase flow and equation of state.

Principal areas of interest and expertise include flow assurance analysis involving transient systems behavior; hydrates; organic and inorganic scale mitigation; pipeline thermohydraulic design and performance evaluation; process engineering for hydrocarbon-processing facilities; wellbore performance and flow dynamics; numerical simulation in reservoir engineering; well test interpretation; field start-up and commissioning operations; hydrocarbon production system design, commissioning, and operational optimization; CO_2 capture, transportation, and storage system design and performance evaluation; and plastics-recycling technologies; and produced water management for a higher circularity.

August 2021–January 2023: Research Assistant, EERC, UND.

- Developed two-phase flow loop for flow behavior study in unconventional extended-reach wells.
- Investigated undulated horizontal Bakken well transient multiphase flow behavior.
- Performed severe slugging attenuation experiments and dynamic simulation.
- Delivered process engineering design studies of flare reduction technology for surface facilities.
- Delivered transient multiphase flow performance of water alternating gas (WAG)–huff ‘n’ puff injection in horizontal wells.

July 2018–June 2021: Account Manager, Badische Anilin Und Soda Fabrik (BASF), Algiers, Algeria.

- Initiated business relationships for refinery, fuels, and lubricant products, increasing company’s revenue.
- Developed private and state-owned company portfolios, increasing product sales pipeline.
- Performed technical sales tasks ensuring customer refinery products complied with required standards.

- Led resid fluid catalytic cracking (RFCC) catalyst business sales operation, ensuring higher gasoline yields to customers.
- Demonstrated solid knowledge in large tender's management, leading to successful contracts signatures.
- Developed business strategy for key accounts, resulting in concise objectives.

September 2016–July 2018: Process and Flow Assurance Engineer, Japanese Gasoline Corporation (JGC), Algiers, Algeria.

- Delivered flow assurance studies for conceptual and feasibility, front-end engineering and design (FEED), and engineering, procurement, and construction (EPC) for hydrocarbon-processing facilities; hydrates; inorganic-scale formation and mitigation study delivery.
- Performed multiphase pump performance analysis study, enabling development scenario comparison; commissioning procedures preparation; enabling project-commissioning activities; and start-up activities execution, enabling LDBP-4 gas station start-up with start-up issues resolution.

May 2014–December 2015: Petro-Technical Engineer, Schlumberger, Algiers, Algeria.

- Delivered flow assurance consulting study, enabling operating company to relieve back-pressure effect on its wells.
- Performed technical sales tasks related to customer presentations, workshops, and delivery for North African region.
- Delivered software technical support for existing customers, solving PETREL®, OLGA®, PIPESIM®, and OFM® technical issues; and delivered software training courses on production software.

Publications

Has authored and coauthored several peer-reviewed and other professional publications.

BRADLEY G. STEVENS, P.E.
Principal Research Engineer, Civil Engineering
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5293, bstevens@undeerc.org

Education and Training

B.S., Civil Engineering, University of North Dakota, 1989.
Registered Professional Engineer – North Dakota No. PE-4340.

Research and Professional Experience

2022–Present: Principal Research Engineer, Civil Engineering, EERC, UND.

- Responsibilities include managing variety of projects and tasks in areas of oil and gas production and processing, hydrogen production and utilization, electrical grid resiliency, and risk mitigation.
- Expertise includes soil, groundwater, and industrial process water remediation; process instrumentation and control; wind power generation; hydrogen production; and oil and gas production.

2021–2022: Senior Research Engineer, Civil Engineering Team Lead, EERC, UND.

2011–2021: Senior Research Engineer, EERC, UND.

- Responsibilities included execution of wide-ranging projects under EERC's Bakken Production Optimization Program, including study of alternative natural gas use, saline and hydrocarbon soil remediation, and statistical analysis of various oil and gas industry segments.

2005–2011: Research Manager/Engineer, EERC, UND.

- Responsibilities included management of the EERC's Plains Organization for Wind Energy Resources® (POWER®) wind energy program. POWER management duties included strategic planning, fiscal management, program presentation, proposal preparation, and personnel management. Technical duties included installation and setup of wind-monitoring equipment, assessment and analysis of wind resource data, wind turbine production estimates, and theoretical project economics.
- Other responsibilities included supervision of design, installation, and operation of electrolysis-derived hydrogen production and dispensing system.

1998–2005: Research Engineer, Remediation, EERC, UND.

- Responsibilities included management, testing, data analysis, and report preparation for commercial application of centrifugal membrane filtration; project management, specification, construction, and demonstration of freeze–thaw process for utilization of marginal waters; participation in Red River Water Management Consortium (RRWMC) as technical staff member advising RRWMC members regarding pertinent water supply and water quality issues; management and operation of and data analysis and report preparation for sorption and regeneration process for mercury removal from primary and secondary liquid wastes assessment; and data analysis activities related to wind energy.

1992–1998: Project Manager/Engineer, Summit Envirosolutions, Inc., Minneapolis, Minnesota.

- Responsibilities included specification and coordination of installation of remote data acquisition equipment for municipalities in Minnesota for use as aquifer resource management tools; specification, installation, and maintenance of groundwater flow control and flow measurement equipment in association with research and development cooperative agreement with NASA involving state-of-the-art methods of remote data acquisition, patented as RealFlow®; design, installation, and maintenance of permanent and mobile remediation systems in Minnesota, Wisconsin, Nevada, and Arizona, including groundwater pump-and-treat systems, soil vapor extraction systems, and coupled air sparging–soil vapor extraction systems; and management of 20 projects in Minnesota, Wisconsin, and Illinois involving mechanical and electrical control and data retrieval for remedial systems including telemetry-based remedial systems. Other pertinent experience included work with programmable logic controllers and ladder logic programming and training in the use of Intellution FIX DMACS human–machine interface software.

1990–1992: Project Engineer, Delta Environmental Consultants, Inc., St. Paul, Minnesota.

- Responsibilities included design, permitting, installation, and operation of treatment systems for remediation of contaminated groundwater and soils. Sites ranged from automotive service stations to railroad maintenance yards for projects located in a five-state region. Remediation technologies included subsurface air sparging and soil vapor extraction.
- Other project responsibilities included data interpretation and permit compliance for 14 remediation systems for a major oil company; supervising excavation of contaminated soils; and permitting and supervising in-place abandonment of 12,000-gal underground storage tank.

1988–1990: Research/Engineering Technician, EERC, UND.

- Responsibilities included design, construction, operation, maintenance, data collection and reduction, and formal report preparation for bench-scale treatability programs involving single-stage, two-stage, coupled nitrification–denitrification activated sludge systems, activated carbon adsorption, and ion exchange treatment of coal-processing waters. Maintained and operated pure oxygen plug flow reactor for biological treatment of synthetic wastewater. Assisted in production of pilot-scale wastewater treatment facility and design and analysis of bench-scale wastewater treatment models.

Patents

Barrett, D.P.; Davis, R.J.; Dustman, J.E.; Gibas, D.R.; Stevens, B.G.L.; Wilson, B.T. Measuring System for Measuring Real-Time Groundwater Data. U.S. Patent 5,553,492, Sept 10, 1996.

Publications

Has authored or coauthored numerous publications.

APPENDIX C

COST-SHARE COMMITMENT LETTERS

October 15, 2024

Mr. Brent Brannan
Director
Oil & Gas Research Program
State Capitol, 14th Floor
600 E Boulevard Ave.
Dept.405
Bismarck, ND 58505-0840

Subject: Proposal Entitled "Breaking New Ground in Flaring Reduction"

Dear Mr. Brannan:

Steffes, LLC located in Dickinson, ND is a lead supplier of oil and gas facility equipment and widely known for our innovative variable orifice flare which achieves 99% destruction efficiency. Steffes is innovating again through collaborating with the EERC to implement new technology for gas capture. The insight of the North Dakota legislature to incentivize the industry with the Clean Natural Gas Capture and Emissions Reduction Grant Program is timely given the compliance requirements that are presently evolving with respect to the EPA's OOOOb, and OOOOc regulations.

Steffes will provide $741,841 of in-kind cost share to support installation and piloting of 30 new gas capture units to the field to advance gas capture from well-sites. These units are a step-change in technology with respect to conventional vapor recovery and provide new tools for industry to capture the most economically challenging gas that would otherwise be flared.

Sincerely,

Todd Mayer
Steffes, LLC

ADVANCED FLOW SOLUTIONS

October 25, 2024

Mr. Brent Brannan
Director
Oil & Gas Research Program
State Capitol, 14th Floor
600 E Boulevard Ave.
Dept.405
Bismarck, ND 58505-0840

Subject:Proposal Entitled "Breaking New Ground in Flaring Reduction"

Dear Mr. Brannan:

On behalf of Advanced Flow Solutions, a Unit of IDEX Corporation, we are pleased to participate in the North Dakota Industrial Commission's (NDIC) Clean Natural Gas Capture and Emissions Reduction Program and in accordance with the proposal submitted to the North Dakota Oil and Gas Research Program (OGRP).

Advanced Flow Solutions is a manufacturer of natural gas compression with a century long history of suppling solutions for the oil and gas industry. We are providing innovations for reducing flaring across the natural gas value chain. The present opportunity is an excellent collaboration of industry, research, and state support to implement advanced technology.

We are bringing new products to the oil and gas industry to accelerate environmental performance and cost effectively meet compliance targets with new Methane rules. Advanced Flow Solutions is committing $1,824,500 of in-kind cost share[1] over the term of the project. The grant opportunity offered by the North Dakota legislature is an important and timely incentive.

We express our support for the proposed project and look forward to working with the project team.

Sincerely,

John Hays
Business Line Leader
Advanced Flow Solutions

[1] For methane recovery / abatement compressor technology development expenses incurred from 7/1/23 through 6/30/25

LIQUID CONTROLS® CORKEN

Advanced Flow Solutions Main Office & Mfg.
9201 North I-35 Service Road, Oklahoma City, OK 73131
+1 (405) 946-5576
www.LCmeter.com
www.Corken.com

S.A.M.P.I.

SAMPI S.P.A. Office and Mfg.
Via A. Vespucci, 1, 55011, Altopascio, Lucca – Italy
+39 0583 24751
www.sampi.it

APPENDIX D

BUDGET JUSTIFICATION

BUDGET JUSTIFICATION

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 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: Fringe benefits consist of two components which are budgeted as a percentage of direct labor. The first component 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. Only the actual approved rate will be charged to the project. The second component 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.

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 https://campus.und.edu/finance/procurement-and-payment-services/travel/travel.html (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: The equipment for the project includes 30 gas capture units. Each unit has a capacity to capture 50 MCFD of associated gas at a pressure differential of 70 psi. The equipment is necessary to carry out the objectives of the Clean Natural Gas Capture and Emissions Reduction Program which includes capturing natural gas which would have otherwise been flared. The project will pilot the equipment for the purpose of accelerating industry adoption and reducing the flaring of gas in North Dakota.

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 – TBD Site Support: Potential for electrical services support for 30 field units

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.

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.

Technical Software use fee for advanced project management tool. Costs associated with software, data entry, maintenance and enhancement of the system.

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.

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.

Outside Lab – Gas Sampling: Will be utilized to collect and analyze gas samples from the project sites.

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 - Advanced Flow Systems (AFS): – AFS is a natural gas compressor manufacturer. AFS has developed a completely new compressor for the oil and gas industry that is specifically designed for the liquids content of Bakken produced gas. The new design drastically reduces operation and maintenance costs and outcompetes conventional vapor recovery compression. AFS costs share during the legislative biennium 7/2023 – 6/2025 includes the engineering and development costs to produce this new machine, including product testing. AFS will support production and continued development costs during the project. AFS has committed to provide $1,824,500 in cost share.

Cost Share - Steffes: Steffes LLC is a manufacturer, supplier, and service provider for the oil and gas industry providing surface facility equipment. Steffes integrates the AFS compressor into a complete gas capture unit for oil and gas applications. Steffes cost share includes the engineering, drafting, and product testing occurring during the legislative biennium 7/2023 – 6/2025 and the continued development and service costs during the project. Steffes is the supplier of the equipment for the proposed project. Steffes has committed to provide $741,841 in cost share.

Cost share for this project is being proposed at $2,566,341, of which a portion has been incurred prior to the start of the NDIC portion of the project but within the legislative biennium 7/23 – 6/25.

APPENDIX E

STATUS-OF-ONGOING-PROJECTS LIST

STATUS-OF-ONGOING-PROJECTS LIST

Project Title	Contract Award No.
Bakken Production Optimization Program 4.0	G-058-115
Improving EOR Performance Through Data Analytics and Next-Generation Controllable Completions	G-050-97
iPIPE: The Intelligent Pipeline Integrity Program	G-046-88
iPIPE 3.0: The Intelligent Pipeline Integrity Program	G-059-116
PCOR Initiative to Accelerate CCUS Deployment	G-050-96