EERC

Energy & Environmental Research Center
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November 1, 2023

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

Dear Mr. Haase:

Subject: EERC Proposal No. 2024-0046 Entitled "iPIPE 3.0"

The Energy & Environmental Research Center (EERC) in coordination with members of the intelligent Pipeline Integrity Program (iPIPE) is requesting support for a 2-year program (January 2024 through December 2025) focused on innovation of leak detection and prevention technology. The funding, requested from the Oil and Gas Research Program (OGRP), is $3,000,000 of which $1,000,000 is contingent upon the outcome of in-kind match obtained from the project's technology selection process. Matching funds will be provided to OGRP from an industry contribution of $900,000 cash and in-kind cost share of $2,100,000 resulting from the technology selection process commensurate with the contingency stated above.

Since inception in 2018, iPIPE has developed a core group of industry partners focused on the development of technology to reduce the frequency and duration of pipeline releases. iPIPE members operate upstream and midstream oil and gas assets including gathering systems and long-distance pipelines that process North Dakota's products and move these commodities to the marketplace. iPIPE member assets cover a significant footprint in North Dakota and account for most of the gas, natural gas liquids, crude oil, and produced water transported within the state. iPIPE is an important industry collaboration that combines perspectives and conducts projects that are pertinent to the collective interest. The program has been successfully conducting projects that break new ground and provide important feedback on new techniques. The members would like to continue the innovation that iPIPE enables. We greatly appreciate the vision of OGRP in electing to recommend to the North Dakota Industrial Commission funding for iPIPE.

The EERC is a research organization within the University of North Dakota, an institution of higher education within the state of North Dakota, and is not a taxable entity; therefore, it has no tax liability. The $100 application fee (Check 2743) was delivered by UPS October 30, 2023. If you have any questions, please feel free to contact me by phone at (701) 777-5201 or by email at dschmidt@undeerc.org.

Sincerely,

DocuSigned by:
Darren Schmidt
DBBB990DF8C34D8...

Darren D. Schmidt
Assistant Director for Subsurface R&D
iPIPE Program Manager

Approved by:

DocuSigned by:

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Charles D. Gorecki, CEO
Energy & Environmental Research Center

DDS/kal
Attachment

UND UNIVERSITY OF NORTH DAKOTA

Oil and Gas Research Program

North Dakota

Industrial Commission

Application

Project Title: iPIPE 3.0

Applicant: Energy & Environmental Research Center

Principal Investigator: Darren Schmidt, EERC

Date of Application: November 1, 2023

Amount of Request: $3,000,000

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

Duration of Project: 24 months

Point of Contact (POC): Darren Schmidt

POC Telephone: (701) 739-5680

POC E-Mail Address: dschmidt@undeerc.org

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

TABLE OF CONTENTS

ABSTRACT

Objective: The goal of the intelligent Pipeline Integrity Program (iPIPE) is to advance technologies that reduce the frequency and duration of pipeline releases.

Expected Results: iPIPE has accelerated the advancement of technology to improve pipeline integrity. Members gain hands-on experience through iPIPE projects and, as a result, realize early adoption of technology that benefits the asset. iPIPE 3.0 will continue to scout and conduct technology projects that advance leak detection and prevention. Projects are anticipated to include pipeline sensors, new techniques that can collect integrity data anywhere along the pipeline, and remote monitoring such as aerial and satellite surveillance. New to iPIPE 3.0 is a focus to scout technology that can assist with methane detection. iPIPE conducts an annual forum and monthly meetings that engage members in collaboration. Reports are delivered by the Energy & Environmental Research Center (EERC) to the Oil and Gas Research program (OGRP) and iPIPE members. iPIPE's results build confidence in early adoption of technology and impact pipeline assets in North Dakota.

Duration: The duration of the proposed program is January 2024 through December 2025.

Total Project Cost: The total project cost is $6,000,000. The request to OGRP is for $3,000,000, with $1,000,000 to be contingent upon the outcome of the technology selection process. OGRP funding will be matched with $900,000 cash from iPIPE members and in-kind support from technology suppliers totaling $2,100,000 with the above-stated commensurate contingency.

Participants: Participants include the EERC, Oneok, Inc.; Hess Corporation; Energy Transfer; TC Energy Corporation; Marathon Petroleum Logistics (MPLx); and one additional industry partner.

PROJECT DESCRIPTION

The intelligent Pipeline Integrity Program (iPIPE) includes industry organizations that account for a majority of oil and gas in North Dakota gathered and transported to commodity markets. iPIPE is the industry's response to Governor Doug Burgum's challenge to eliminate pipeline leaks through innovation.[1] The program is a pinnacle in demonstrating the option for innovation over regulation. Since 2018, iPIPE has vetted over 145 technologies and conducted 12 technology projects that have ranged from technology on the pipe to technology orbiting the earth. Members of iPIPE collaborate on a monthly basis to discuss advancements in leak detection and conduct technology projects that explore applications within their assets. The Energy & Environmental Research Center (EERC) manages the activity of iPIPE, which includes technology scouting, technical evaluation, contract management, field activity, project performance, reporting, and coordination of member meetings.

iPIPE conducts technology projects selected by the membership. Projects provide for a hands-on experience designed to understand the effectiveness of new technology which can lead to early adoption and an accelerated impact for members and the state of North Dakota. As an example, early iPIPE projects explored the capability of remote monitoring of oil and gas assets from space. This technology is presently in use in North Dakota because of the iPIPE experience. Familiarity with satellites led to the selection of a second project including advanced sensor technology which was launched this past year aboard two Space-X missions. The project is the start of a larger constellation aimed at providing near-real-time monitoring. Satellite-based asset monitoring is a significant technological advancement for the industry in which iPIPE members are influencing development.

Presently, the membership is conducting iPIPE 2.0. The program is diversified with four projects: 1) a project to enhance manned aircraft right-of-way monitoring by utilization of in-flight sensing

[1] https://www.ndoil.org/industry-responds-to-governors-initiative-to-improve-pipeline-technology-program-funding-approved-by-north-dakota-industrial-commission/.

technology; 2) development of a new sensor for remote site applications where detection of hydrocarbons triggers capture of an optical and multispectral image, thus reducing false positives and providing immediate incident inspection; 3) acoustic sensing for more frequent and affordable pipeline inspections; and 4) advanced computational pipeline monitoring applied specifically to produced water systems. Past projects are highlighted in Appendix A.

iPIPE 3.0 is a continuation of the previous program and will be enhanced with increased funding from the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP) and in-kind support from technology suppliers. iPIPE members are eager to maintain momentum and continue the program (see corporate acknowledgments, Appendix B). New for iPIPE 3.0 is a focus on scouting for technologies targeted at methane detection and greenhouse gas emissions. The membership intends to keep continuity of operations with the present program structure. The members appreciate the technology scouting and collective selection of projects and are excited about achieving an even greater scope in iPIPE 3.0. Members have provided letters of support in Appendix C.

Objectives:

The goal of the program is to advance technologies that reduce the frequency and duration of pipeline releases.

Objectives to achieve the program goal are as follows:

- Select projects for demonstration from the technology-scouting efforts, which are approved by the membership.
- Grow industry membership.
- Foster industry collaboration through monthly member meetings and an annual member forum.
- Advance technology to commercial application, with at least one project achieving commercial deployment.

Methodology:

iPIPE achieves program objectives through collaboration with and coordination of industry members, technical contributions, and project management. The membership meets monthly at a minimum and hosts a technology selection event and an annual member forum. A significant scouting effort is conducted by the EERC to screen technology, invite organizations to propose projects, and select proposals for review by the iPIPE technology selection committee. Monthly meetings provide updates on projects and an opportunity to conduct member business. The EERC coordinates member business and conducts the technical work to prepare for the technology selection event, member forums, and completion of research projects. The EERC is the contracting authority with OGRP and manages agreements with member companies. Each industry member designates a representative with voting rights who provides guidance to the program. Members vote on technology selections and program recommendations. Industry members are expected to contribute experience and be hands-on, offering facilities in which to demonstrate technology. The EERC provides expertise, coordinates projects and contracts, and assists in technology advancement and documentation.

The EERC scouts for technology, providing a service to the iPIPE members to communicate and screen organizations that may qualify for iPIPE's technology selection event. The EERC maintains a database that continues to grow and includes more than 145 pipeline technology organizations. Qualifying organizations are invited to submit a proposal for the technology selection event. A technology selection event will be completed early in 2024. Technology providers become successful applicants if they are evaluated positively relative to the following:

- Likelihood the technology will improve leak prevention or leak detection.
- Likelihood the technology will be deployed on member assets.
- Ability for the proposed demonstration to be achieved within budget and schedule.
- Quality of the methodology to achieve the objectives and the scientific merit.

- Likelihood the demonstration will advance the technology toward commercialization.
- The technology provider will provide a high value to the program (in-kind support).

iPIPE members determine support for technology demonstrations based on the quantity and quality of proposals relative to program budget and objectives. EERC contracts and manages technology projects with the awarded providers. Progress is discussed at monthly meetings, and decisions relative to the program are determined. Upon completion of projects, the EERC issues a report to members and updates OGRP. Annual member forums are used to discuss technology and provide networking among organizations.

Organizations are eligible to join iPIPE if they are operators of wells or gathering, transmission, or distribution pipeline systems. Members individually contribute $75,000 per year. Member obligations are designated in an invoice agreement between the EERC and the organization. Each industry organization selects a representative with one vote on any subject brought to the membership. The representative may vote by proxy. Quorum is achieved by majority. The order of business for iPIPE meetings includes an agenda provided 1 week in advance to notify the membership of upcoming decisions. The meeting is called to order, a quorum is determined, and previous meeting minutes are read and approved. The membership is provided with an update on projects, program finances, program development, and membership. Unfinished business, new business, and any other business for the good of the order is conducted, followed by adjournment.

Anticipated Results:

iPIPE 3.0 is expected to build on previous success. Technology selection rounds completed in the previous program are summarized in Table 1. Over 145 technologies were screened to ultimately produce 12 projects. iPIPE 3.0 will leverage the existing technology pool and conduct a technology selection event within the program. Because of increased funding, the technology selection process is anticipated to produce a greater number and scale of projects.

Table 1. Technology Screening and Selection

	iPIPE 1.0 First Round	**iPIPE 1.0** Second Round	**iPIPE 1.0** Third Round	**iPIPE 1.0** Fourth Round	**iPIPE 2.0**	**Total**
Invited:	7	21	62	58	47	145+
Proposals:	7	10	14	24	14	69
Presented:	7	9	8	10	9	43
Selected:	2	4*	2	2	4	14

* Two selections were unable to agree upon terms, so contracting did not occur.

Proposals presented to iPIPE 3.0 are anticipated to achieve a step-change in leak detection and leak prevention technology. iPIPE 3.0 will continue to advance applications for in-line inspection, artificial intelligence monitoring, intelligent pipeline sensors, and remote inspection. At least one technology from the technology selection event is expected to achieve commercial deployment as a result of advancements achieved through iPIPE support. iPIPE 3.0 will also build on our satellite experience as we receive detection and alert data and evaluate accuracy and resolution of satellite-based detection capabilities.

Efforts will continue to market and grow the program to add members and revenue. Mergers and acquisitions that occurred during iPIPE 2.0 considerably expanded iPIPE's footprint in North Dakota including the acquisition of Crestwood which formally acquired Oasis Midstream. Members of iPIPE 3.0 cover significant portions of North Dakota pipeline infrastructure.

Facilities:

iPIPE members own and operate oil and gas pipelines and facilities, which are provided to demonstrate selected technologies. The EERC offers over 54,000 ft^2 of demonstration facilities that can accommodate a variety of technologies. The space allows for custom construction of new pilot-scale components to fit client needs.

Resources:

The EERC provides direct labor including a program director, a project director, a program manager, and project support for iPIPE activity. Additional support is provided through contract specialists, administrative support, and communications personnel. Personnel are dedicated throughout the program. Each industry organization provides a representative to iPIPE. The representative has direct input to the program and responsibility to manage additional specialized support for technology projects. iPIPE offers significant value to participants, in which technology providers are required to provide in-kind cost share. Support is subject to the technology provider's offering and capabilities.

Techniques to Be Used, Their Availability and Capability:

The EERC provides technical expertise and field sampling experience for off-site demonstrations. The EERC employs over 280 people available for technology projects.

Environmental and Economic Impacts While Project Is Underway:

No environmental releases occurred during the past years of the program, and future work is not expected to impact the environment. Project demonstrations utilize local services, resulting in some local economic stimulation.

Ultimate Technological and Economic Impacts:

The advancement of technology to safeguard pipeline infrastructure and continuously improve leak detection and leak prevention is vital to North Dakota's economy. The oil and natural gas industry accounted for more than $42.6 billion to North Dakota's economy, supporting nearly 50,000 jobs and over $3.4 billion in state and local tax revenues in 2021, according to the North Dakota Petroleum Foundation.[2] Pipeline infrastructure is critical to North Dakota's economy to competitively transport oil, produced water, gas, and natural gas liquids (NGLs). North Dakota is among the top three oil producers in the United States, producing over 1.1 million barrels of oil per day, 1.6 million barrels of produced

[2] https://ndpetroleumfoundation.org/bakken-benefits/opportunity/.

water per day, and 3 billion cubic feet of gas per day, which includes approximately 750,000 barrels per day of NGLs.[3] The demand for pipeline infrastructure is projected to grow, and iPIPE has invested over $5.4 million to accelerate leak prevention and leak detection technologies. Continuing with iPIPE 3.0 will bolster existing efforts, incubate new emerging technologies, and provide the innovation needed to remain competitive.

Why the Project Is Needed:

As the chairman of NDIC, Governor Doug Burgum has stated, "We have a goal of zero leaks and spills."[4] This aspiration is yet to be achieved, and iPIPE 3.0 allows the continuation of the journey to an era of zero pipeline releases. iPIPE 3.0 is aligned with North Dakota's initiatives to innovate. The program accelerates the growth and commercialization of technology specific to pipelines. Technology providers are anticipating participating in the next technology selection event; without continuation of iPIPE 3.0, momentum would be slowed and a North Dakota-based program to engage industry and technology entrepreneurs would be diminished. It is important for iPIPE 3.0 to continue technology development, which ultimately decreases the risks facing the industry. Artificial intelligence, machine learning, satellite, and drone-based technologies are developing rapidly. iPIPE 3.0 is needed to provide collaborative industry direction that streamlines the deployment of these technologies. The membership appreciates the technology scouting, quick turn-around time, and hands-on opportunity that iPIPE provides. The program has the track record and experience to continue success and cannot continue without the support of OGRP.

[3] https://ndpipelines.files.wordpress.com/2023/07/kringstad-nd-ogrp-7-21-23.pdf.
[4] https://news.prairiepublic.org/local-news/2019-12-18/eerc-led-project-aims-to-reduce-oil-spills.

STANDARDS OF SUCCESS

- **Technology Scouting** – The EERC maintains a database currently comprising over 145 technology providers. Scouting efforts should result in at least ten successful invitations for proposals for the technology selection event.
- **Technology Selection** – iPIPE will complete a technology selection event resulting in projects that are executed over the contracted term of the project.
- **Deployment** – At least one technology will achieve commercial deployment related to iPIPE support.
- **Recognition** – The program will achieve recognition in industry journals or through awards.
- **Reporting** – The EERC delivers program reports to OGRP and members.

The ultimate value to North Dakota is in iPIPE's ability to bring new technology to the industry serving the state in which the technology improves pipeline integrity.

BACKGROUND/QUALIFICATIONS

With support from NDIC through OGRP, the organizations participating in iPIPE 3.0 include the EERC, Hess Corporation; Oneok, Inc.; Energy Transfer; TC Energy Corporation; Marathon Petroleum Logistics (MPLx); and one other corporate member. Industry members operate pipelines and include interstate assets. Organizational qualifications and resumes of key personnel are provided in Appendix D. The EERC's team of dedicated professionals have decades of experience in technical disciplines, research contracts, project management, communications, and government affairs.

MANAGEMENT

iPIPE is managed by Darren Schmidt, Program Director; Austin McRae, Project Director; Michelle Olderbak, Program Manager; and project advisors, Josh Stanislowski and Michael Warmack. The EERC is the contracting authority with OGRP and engages in contracts with the technology providers. The EERC enters into agreements with the iPIPE members that outline the obligations of both parties. The EERC is obligated to the iPIPE membership and is responsible to align membership and OGRP priorities. The

EERC manages project milestones and tracks progress, including financial monitoring and reporting to all parties. iPIPE coordinates and conducts a technology selection event and annual member forum and ensures that activities are on schedule by conducting monthly meetings. iPIPE projects are conducted under contracts with technology providers that specify project milestones tied to financial support.

TIMETABLE

The project period is January 2024 through December 2025, as shown in the timetable below. Project activities and member commitments are for 2 years. The technology selection event will be planned for Quarter (Q) 2 2024. Technology selection is necessary early in the schedule to allow time to complete demonstrations. Events are staggered as new members may join later. The membership will review project completion status and program continuance in the third quarter of 2025.

	2024				2025			
Activity	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Technology Selection		*						
iPIPE Member Forum				*				*
Program Update to OGRP				*				*
Quarterly Reporting	*	*	*	*	*	*	*	*
Comprehensive Final Report								*
Technology Contracting Period								
Member Financial Commitments	*				*			
Decision for Ongoing Program							*	
Completion of All Technology Projects								*

BUDGET

The total cost of the proposed effort is $6,000,000. $3,000,000 is requested from OGRP, with $1,000,000 contingent upon the outcome of the technology selection process. Cost share is provided by iPIPE members totaling $900,000 cash and in-kind support from technology suppliers of $2,100,000 with commensurate contingency. The program is expected to grow in membership and member contributions. In-kind cost share will occur on behalf of technology suppliers and from member support provided for technology demonstration. Current partner organizations have expressed a desire to continue participation in the program. A budget is provided below. Budget notes can be found in Appendix E.

Project-Associated Expense	NDIC Share (cash)	NDIC Contingent (cash)	Member Share (cash and in-kind)	Member Contingent (cash)	Total Project
Labor	$0	$0	$499,307	$0	$499,307
Travel	$0	$0	$28,953	$0	$28,953
Supplies	$0	$0	$1,200	$0	$1,200
Subcontractor – Technology Selection #1	$487,250	$0	$0	$0	$487,250
Subcontractor – Technology Selection #2	$487,250	$0	$0	$0	$487,250
Subcontractor – Technology Selection #3	$487,250	$0	$0	$0	$487,250
Subcontractor – Technology Selection #4	$487,250	$0	$0	$0	$487,250
Subcontractor – Technology Selection #5	$0	$487,250	$0	$0	$487,250
Subcontractor – Technology Selection #6	$0	$487,250	$0	$0	$487,250
Printing and Duplicating	$0	$0	$580	$0	$580
Food	$0	$0	$3,540	$0	$3,540
Freight	$0	$0	$443	$0	$443
Laboratory Fees and Services					
Document Production Service (Graphics, Editing, and Workflow)	$0	$0	$10,332	$0	$10,332
Software Solution Services	$0	$0	$1,722	$0	$1,722
Technical Software Fee	$0	$0	$145	$0	$145
Engineering Services Fee	$0	$0	$2,859	$0	$2,859
Field Safety Fee	$0	$0	$13,419	$0	$13,419
Total Direct Costs	$1,949,000	$974,500	$562,500	$0	$3,486,000
Facilities and Administration	$51,000	$25,500	$337,500	$0	$414,000
Total Cash Requested	**$2,000,000**	**$1,000,000**	**$900,000**	**$0**	**$3,900,000**
In-Kind Cost Share					
Technology Providers	$0	$0	$1,100,000	$1,000,000	$2,100,000
Total In-Kind Cost Share	**$0**	**$0**	**$1,100,000**	**$1,000,000**	**$2,100,000**
Total Project Costs	**$2,000,000**	**$1,000,000**	**$2,000,000**	**$1,000,000**	**$6,000,000**

TAX LIABILITY

The EERC, a department within the University of North Dakota (UND), is a state-controlled institution of higher education and is not a taxable entity; therefore, it has no tax liability to the state of North Dakota or any of its political subdivisions.

CONFIDENTIAL INFORMATION

No confidential information is included in this application. Confidentiality regarding research activity conducted under the program is handled in separate agreements between the EERC and the parties.

PATENTS/RIGHTS TO TECHNICAL DATA

No patents or rights are identified for reservation in the application.

STATUS OF ONGOING PROJECTS

The EERC is currently engaged in nine OGRP-funded projects as shown in the table below. These projects are ongoing and current on all deliverables.

Project Title	Contract Award No.
iPIPE: The intelligent Pipeline Integrity Program	G-046-88
Improving EOR Performance Through Data Analytics and Next-Generation Controllable Completions	G-050-97
PCOR Initiative to Accelerate CCUS Deployment	G-050-96
Unitized Legacy Oil Fields: Prototypes for Revitalizing Conventional Oil Fields in North Dakota	G-045-086
iPIPE 2.0: The intelligent Pipeline Integrity Program	G-055-108
Bakken Production Optimization Program 4.0	G-058-115

APPENDIX A

PAST PROJECTS

PIPELINE RISK

Application
- Advanced risk identification.
- Leverage ML processes and technology to support pipeline and facility risk mitigation.

Development
- Explored application with customer and regional data.

Success
- Application identifies higher-risk areas of pipeline segments and ranks risk.

MACHINE LEARNING

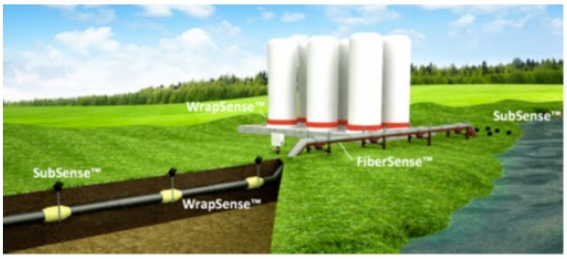
DIRECT-C

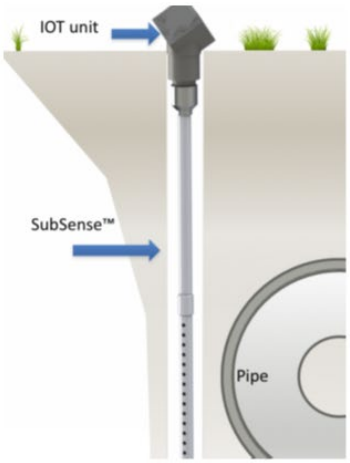
Sensing of Hydrocarbons and Produced Water

Application
- Useful in focused areas.
- Attached on or near pipe and equipment.

Development
- Pushed technology beyond HC application exploring PW.
- Enhanced installation methods, product hardware, alarm algorithms, and remote communications.

Success
- In use in North Dakota.
- Achieved growth in eight states, Canada, and Europe.





INGU SOLUTIONS

Application

- Advanced in-line inspection.
- Advanced technology for gathering lines that are otherwise difficult to inspect.

Development

- Demonstrated Pipers capability in operational pipelines.
- Developed launch and receive methods.
- Validated repeatability between free-floating and cleaning pig deployments.

Success

- INGU has operated in North Dakota and inspected over 300 pipelines for over 100 customers in 15 countries, building a network of nine agents.

SATELYTICS

Application

- Leak detection from space.
- Advanced processing and algorithms of satellite data to provide actionable alerts.

Development

"We often state that iPIPE was beneficial in providing copious amounts of data to train our algorithms. With 3 years of weekly monitoring, our algorithms were provided with an extensive training opportunity." – Sean Donegan, Satelytics President and CEO.

Success

- Deployed commercially in North Dakota on the Pelican Pipeline system.
- Projects with BP: leak detection and chemical and carbon accounting.
- Duke Energy (methane), Central Hudson Gas & Electric, Washington Gas, Southern Company, ADNOC, SoCalGas, ItalGas, Oxy, Dominion Energy.

APPENDIX B

CORPORATE ACKNOWLEDGMENTS

Intelligent Pipeline Integrity Program

Hess continues active involvement in iPIPE, a collaboration of oil and gas operators and the University of North Dakota's Energy and Environmental Research Center, which aims to review advanced technologies that enhance pipeline integrity efforts (including remote emissions monitoring by drones). Hess works with iPIPE members to review a range of technologies and choose a few for additional investment and testing.

Using Advanced Technology to Enhance Release Detection

As part of our commitment to safeguarding the environment, Hess has been supporting the development of advanced release detection technologies for years. In 2022, we further progressed this work by implementing a near daily remote sensing protocol that significantly enhances our release detection capabilities. This technology, developed by Satelytics and supported by Hess since 2018, uses geospatial analytics, proven algorithms and unique data collection methodology to identify, locate and measure potential releases as well as physical risks in both upstream and midstream infrastructure.

Satelytics' approach uses a mix of satellites, drones, stratospheric balloons, airplanes, fixed cameras and onsite hardware to assess specific equipment, overall sites and higher level landscapes for signs of potential releases. They analyze the multispectral imagery that is collected through a combination of automated software and proprietary algorithms and provide alerts to operators when potential issues are detected. This process enables near-continuous measurement, early detection and remote investigation of potential issues.

Our initial implementation of this technology is focused on detecting liquid releases, such as hydrocarbons and produced water. The technology will ultimately be used to detect land movement and erosion, encroachments on right of ways, vegetation management and coarse resolution methane detection.

PARTICIPATION IN KEY RESEARCH PARTNERSHIPS

With our sights set on the future, we continue to collaborate and partner with key organizations inside and outside the energy industry, including the:

- Pipeline Research Council International (PRCI), a community of the world's leading pipeline companies established to develop and deploy research solutions improving pipeline safety and performance,
- PIPE SAFE Group (PSG), an international group of gas transmission companies established to collaborate in the study of the hazards and risks involved in gas transmission by pipelines,
- Emerging Fuels Institute (EFI), of which we are a founding member, addressing the most pressing knowledge gaps in hydrogen,
- Center for Hydrogen Safety group promoting hydrogen safety and best practices worldwide, and
- Intelligent Pipeline Integrity Program (iPIPE) focused on advancing detection of pipeline hazards and leaks.

Transforming Energy Future Continued

In addition, ONEOK Capital Ventures is focused on exploring and investing in innovative technologies that tie to our core business and seek to provide solutions for a transforming energy future. We work with other energy companies to support new technologies and also may make direct equity investments in early-stage energy technology companies that are intended to help improve our operations and are aligned with the energy transformation. Recent investments include:

- **Energy Technology Startup Hub Initiative** - ONEOK, along with leading energy companies and organizations, committed funds towards a new venture capital fund aimed at transforming Oklahoma into a hub for energy technology startups. The initiative intends to attract energy technology startups to the region through access to resources such as free office space, early-stage capital and services to accelerate innovation to meet growing energy demands and create a more sustainable future. By fueling research and development and forward-looking technologies, the initiative is expected to create more than 1,700 jobs across the energy industry.
- **Orbital Sidekick** - ONEOK made a minority direct equity investment in Orbital Sidekick (OSK), a startup company that aims to generate space-based data intelligence using its proprietary constellation of satellites equipped with hyperspectral sensors. Using these satellites, OSK will monitor assets for sustainable operations, ESG and security goals. Hyperspectral imaging (HSI) is a technology that analyzes a wide spectrum of light reflecting off Earth's surfaces. Companies could use the information collected to monitor critical infrastructure, minimize emissions, exceed regulatory requirements and support a lower-carbon future. This technology could also allow companies to scan assets within a day to inspect for damage after a storm.

Prior to investing, ONEOK helped Orbital Sidekick test its technology through participation in the Intelligent Pipeline Integrity Program (iPIPE). ONEOK sees multiple potential future application benefits and potential industry-wide scalability of Orbital Sidekick's technology, including potential opportunities for right-of-way monitoring, vegetation management and erosion monitoring.

Orbital Sidekick satellite

Industry Collaborations

*Energy Transfer aligns with organizations that focus on emissions reductions, sharing in best reporting practices, research, and the development of new technology to **promote safety** and **improve environmental performance**.*

EMERGING FUELS INSTITUTE

PRCI established the Emerging Fuels Institute (EFI) to help resolve the technical gaps that exist as the industry transitions to low carbon energy solutions using the existing pipeline asset infrastructure. Members execute the research needed to ensure the safe transportation and storage of emerging fuels, such as hydrogen, renewable natural gas, and other potential gas and liquid fuel sources, that will help meet the world's energy needs while reducing the impact to the environment. Energy Transfer is a "Vanguard" member and maintains a leadership position in the EFI.

ENERGY INFRASTRUCTURE COUNCIL AND GPA MIDSTREAM

In 2022, the Energy Infrastructure Council (EIC) and GPA Midstream released Version 2.0 of the Midstream ESG Reporting Template. The ESG Reporting Template is the product of an extensive review of best practice ESG reporting among member companies and the ESG reporting requirements from numerous critical stakeholders. The collaborative process included members from both EIC and GPA Midstream (including Energy Transfer) and featured significant participation from in-house ESG specialists and professionals with operational and technical expertise.

INTELLIGENT PIPELINE INTEGRITY PROGRAM

The Intelligent Pipeline Integrity Program (iPIPE) is an industry-led consortium whose focus is to contribute to the advancement of new and emerging technologies to prevent and detect gathering pipeline leaks. Our participation in iPIPE is a proactive industry effort to evaluate new technologies that can be used for leak detection, leak prevention, change detection and pipeline risk modeling.

PIPELINE RESEARCH COUNCIL INTERNATIONAL

The Pipeline Research Council International (PRCI) is an industry research forum for technology developments and projects that assure the safe, reliable, environmentally sound and cost-effective pipeline transportation of energy to consumers worldwide. Energy Transfer participates in a leadership role in PRCI through Board membership and active participation in every technical committee, including the CO_2 Task Force. Many of the research projects focus on the development of new technologies that help reduce direct and indirect emissions from pipeline operations.

Pipeline Surveillance Technology Committee

Our Pipeline Surveillance Technology Committee was formed in 2016 to evaluate available technologies within the pipeline industry and determine implementation potential on Energy Transfer assets. The committee also evaluates current testing and new or advancing technologies within the industry through various industry consortiums and state or federal programs such as iPIPE, PRCI, FAA, HSAC and Texas A&M.

Additional committee functions and 2022 highlights include:

- Recommendations for pilot study programs to be initiated on Energy Transfer assets.
- Increase member participation across business segments (Environmental, Regulatory Affairs, IT – SCADA and Engineering) to broaden groups' ability to address regulatory drivers such as Greenhouse Gases (GHGs), Environmental, Social, Governance (ESG) criteria, Leak Detection and Repair (LDAR) and methane mitigation, and recommend proven technologies that can be deployed for specific applications.
- Utilized Orbital Sidekicks (OSK) Optical Gas Imagery technology via fixed-wing aircraft to satisfy regulatory methane leak detection survey requirements in Southeast New Mexico. OSK's satellite technology enables earlier detection and prevention of leaks along pipeline rights-of-way, using hyperspectral data analysis to drive broad improvements in community safety, environmental performance and overall operating efficiency.
- Guidance on the use of drone technology by company and contractor personnel relative to company assets.
- Evaluated stationary methane detection technology at a gas processing facility in Oklahoma.
- Participated on the Intelligent Pipeline Integrity Program (iPIPE) technology committee managed by the Environmental and Energy Research Center (EERC) from the University of North Dakota which conducted four research projects focused on leak detection (liquid and gas), change detection (geohazards) and pipeline surveillance (damage prevention).
- Participated in the Pipeline Research Council International (PRCI) Surveillance Operations & Monitoring committee which had six active research projects focusing on leak detection, change detection and pipeline surveillance.

APPENDIX C

COMMITMENT LETTERS

October 17, 2023

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

Subject: Program Entitled "iPIPE 3.0”

Dear Mr. Brannan:

Enbridge is committed to our participation in iPIPE and advancing leak detection technology. The program provides scouting of new technology and is aligned with our priorities. Enbridge has been participating with an annual membership of $75,000 per year and will continue into the next program period including support of projects as decided by the membership.

The EERC ‘s proposal matches the iPIPE members’ commitment with the NDIC's Oil & Gas Research Program (OGRP) support. Commitment is contingent on the award of matching funds from the OGRP and other pipeline operators participating in the program.

Sincerely,

Philip K. Martin
Manager, TIS PCSLD Leak Detection, Enbridge Inc.

ENERGY TRANSFER

October 9, 2023

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

Subject: Program Entitled "iPIPE 3.0"

Dear Mr. Brannan:

Energy Transfer is actively engaged in the iPIPE program and wishes to continue with the members and the EERC for iPIPE 3.0. The program helps to realize new technology that is on the cutting edge of leak detection and prevention. Continuing the program builds on our success and fosters collaboration.

Energy Transfer, in collaboration with other members of the iPIPE consortium, is committing $75,000 per year for the proposed program to be matched with OGRP support. iPIPE members are committed to providing in-kind support for project demonstrations at facilities decided by the membership. Commitment is contingent on the award of matching funds from NDIC's Oil & Gas Research Program and other pipeline operators participating in the program.

Sincerely,

K. Grant Ruckel
Vice President, Government Affairs

KGR:jb

8111 Westchester Drive | Dallas, Texas 75225 | (214) 981-0700 | (214) 981-0703 (fax)

Hess Corporation
1501 McKinney Street
Houston, TX 77010

October 1, 2023

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

Subject: Program Entitled "iPIPE – intelligent Pipeline Integrity Program"

Dear Mr. Brannan:

This letter is provided to convey Hess Corporation's intent to fund and actively participate in iPIPE in accordance with the proposal submitted to the North Dakota Oil and Gas Research Program (OGRP). We believe this industry-led research builds on our previous success and accelerates innovation for pipeline integrity. The program is driving innovation of new technology for pipeline leak detection and prevention. Continuing the program provides continuity among our members and assists the adoption of new technology.

Hess Corporation, in collaboration with other members of the iPIPE consortium, is committing $75,000 per year for the proposed program to be matched with OGRP support. iPIPE members are committed to providing in-kind support for project demonstrations at facilities decided by the membership. Hess Corporation's commitment is contingent on the award of matching funds from NDIC's Oil & Gas Research Program and other pipeline operators participating in the program.

Sincerely,

Brent Lohnes
General Manager-North Dakota
Hess Corporation

Marathon Petroleum Logistics

1611 E. Century Ave., Ste. 300
Bismarck, ND 58503

October 1, 2023

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

Subject: Program Entitled "iPIPE – intelligent Pipeline Integrity Program"

Dear Mr. Brannan:

This letter is provided to convey Marathon Petroleum Logistics' (MPLX) intent to participate in iPIPE in accordance with the proposal submitted to the North Dakota Oil and Gas Research Program (OGRP). We believe this industry-led research builds on our previous work and accelerates innovation for pipeline integrity. MPLX intends to provide $75,000 per year as a member of the program and will support projects as decided by the membership. MPLX's commitment is contingent on the award of matching funds from the OGRP and other pipeline operators participating in the program.

Sincerely,

Darren Snow
Director
North West Area of Operations
Marathon Petroleum Logistics

October 26, 2023

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

Subject: Program Entitled "iPIPE 3.0"

Dear Mr. Brannan:

ONEOK has been a committed member of iPIPE and pleased to be on the forefront on technology with the EERC and the iPIPE member organizations. ONEOK intends to continue with the iPIPE 3.0 program at $75,000 per year to be matched with the North Dakota Oil and Gas Research Program (OGRP) funding. Participation is contingent on the award from the OGRP and the iPIPE members' participation. ONEOK has been supporting iPIPE projects with in-kind participation and intends to continue based on decisions by the membership.

Sincerely,

Jeffrey Ector
Supervisor Prevention & Mitigation
ONEOK, Inc.

From: Tania Rizwan <tania_rizwan@tcenergy.com>
Sent: Friday, October 27, 2023 6:57:04 PM
To: Schmidt, Darren <dschmidt@undeerc.org>
Cc: Thamar Mora <thamar_mora@tcenergy.com>
Subject: RE: [EXTERNAL] iPIPE proposal

Hi Darren,
Thamar asked me to respond on her behalf as she is travelling for work.

We are pleased to let you know we've received positive response from our management to move ahead with being a part of iPIPE 3.0. As you know TC Energy has been an integral part of iPIPE 2.0 and we see value in continuing this partnership in the next year with iPIPE 3.0. We appreciate your patience as we work through the logistics of identifying the funding of this membership internally and will provide the formal letter as soon as that is confirmed and finalized.

Thank you again for your patience.

Best Regards,

Tania Rizwan Ph.D., P.Eng. (she/her)
Senior Leak Detection Engineer
Leak Detection Engineering, Liquids Operations
Desk: (587)-933-3364 Mobile: (403)-6837-1439

APPENDIX D

RESUMES AND ORGANIZATION QUALIFICATIONS

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.

T. AUSTIN MCRAE
Oilfield Operations Specialist
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5402, amcrae@undeerc.org

Education and Training

B.S., Petroleum Engineering, Colorado School of Mines, Golden, Colorado, 2014.

Proficient in the use of Microsoft Office Suite, Baker Hughes Job Monitoring Programs, Windows XP, 7, 8, 10.

Certifications include SafeGulf, SafeLandUSA, and Core Compliance (PEC Safety) and Baker Hughes Engineer Development Program and Stimulation Technical Academy.

Research and Professional Expérience

2016–Present: Research Engineer, Integrated Petroleum Systems, EERC, UND.

- Works in the areas of process engineering and design for wellsite operations, pipeline transport, environmental science related to oilfield operations, and operation of pilot-scale carbon capture systems.
- Serves as Co-Project Manager of the Intelligent Pipeline Integrity Program (iPIPE) at the EERC, an industry-led consortium whose focus is to contribute to the advancement of near-commercial, emerging technologies to prevent and detect leaks from gathering pipelines, and serves as Chief Technology Scout for iPIPE, the primary contact for interested technology developers. Accomplishments have included:
  - Searching for and identifying most promising emerging technologies.
  - Assessing fit of potential technologies with program and communicating iPIPE goals to technology providers.
  - Helping technology providers understand how to address needs of member companies with their products.
  - Assisting engaged technology providers in honing their proposals to meet member expectations.
  - Offering project support, as needed, particularly in the field.

Principal areas of interest and expertise include petroleum industry operations and support, specifically well stimulation; enhancing coordination between energy industry and environmental efforts through improved technology, practice, and understanding; and advanced energy technologies.

2016: Supply & Logistics Coordinator – AmeriCorps National Service Member, SBP (formerly St. Bernard Project), New Orleans, Louisiana/Columbia, South Carolina.

- Worked directly with project managers to ensure all active home construction sites and field personnel received necessary materials and support; managed warehouse stock, tools, and materials while assisting in procurement of nonstock items; and assisted in delivery and transport of all items. Accomplishments included:
  - Assisting team with cross-town warehouse move, including new layout design, vehicle logistics, and storage construction.
  - Improving vehicle safety within organization through implementation of experience best practices and increased load securement awareness.

  - Creating safer construction sites through application of affordable security measures specifically intended to deter intruders at all times and better secure valuable tools and resources overnight.

2014–2015: Stimulation/Field Engineer, Permian Basin, Baker Hughes Pressure Pumping, Artesia and Hobbs, New Mexico/Odessa, Texas.

- Responsibilities included ensuring technical product and service delivery through laboratory and field testing, technician management, on-site job monitoring, and customer interaction; analyzing job results; and generating posttreatment and regulatory reports. Accomplishments included:
  - Enhancing service delivery by pumping and changing between multiple fluid systems as needed based on customer request and preference.
  - Avoiding nonproductive time (NPT) by anticipating customer requests and having additional products available on location for critical or experimental wells.
  - Managing jobs from beginning to end on locations throughout Permian Basin, treating multiple formations using slickwater, crosslinked, produced water, acid, and hybrid systems.
  - Maintaining and promoting interdependent safety culture regardless of customer or location, resulting in zero injuries or incidents while present or involved.

2013: Roustabout, Champion Oilfield Service, Wiggins, Colorado.

- Collaborated with a multifunctional team to construct and maintain oilfield infrastructure for operators in Denver–Julesberg Basin. Projects included building tank batteries, repairing compressors and pumping units, and creating flow lines from wellhead to separators, batteries, and sales lines. Accomplishments included:
  - Minimizing hydrocarbon gas emissions into atmosphere through thorough pipe testing, inspection, and repair before installing underground and connecting to live system.
  - Conducting operations in safest possible manner, resulting in zero injuries to self or team as well as minimal waste and litter to environments surrounding construction sites.

2012: Construction Office Coordinator, St. Bernard Project, New Orleans, Louisiana.

- Coordinated and communicated between multiple on-site and centrally located project managers to ensure smooth rehabilitation and repair of homes for people most adversely affected by Hurricane Katrina, including interfacing with local government agencies, obtaining permits, and ensuring projects met codes and standards.

Professional Activities

Member, Society of Petroleum Engineers

Publications and Presentations

Has authored or coauthored several professional publications.

JOSHUA J. STANISLOWSKI
Director of Energy Systems Development
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5087, jstanislowski@undeerc.org

Education and Training

M.S., Chemical Engineering, University of North Dakota, 2012.
B.S., Chemical Engineering, University of North Dakota, 2000.
Six Sigma Green Belt Certified, August 2004.

Research and Professional Experience

August 2019–Present: Director of Energy Systems Development, EERC, UND.

- Leads multidisciplinary team of scientists and engineers focused on research, development, and commercialization of innovative energy technologies as they relate to coal utilization and emissions, carbon management, and alternative fuels and renewable energy.
- Serves as Co-Project Manager of Intelligent Pipeline Integrity Program (iPIPE) at EERC, an industry-led consortium whose focus is to contribute to advancement of near-commercial, emerging technologies to prevent and detect leaks from gathering pipelines.
- Principal areas of interest and expertise include coal and biomass gasification systems with an emphasis on novel syngas cooling, cleanup, and separation technologies.
- Has worked extensively with hydrogen separation membrane systems and liquid fuels catalysis. Proficient in process modeling and systems engineering including techno-economic studies using Aspen Plus software.
- Has significant experience with process engineering, process controls, and project management.
- Has a strong background in gauge studies, experimental design, and data analysis.

2015–July 2019: Principal Process Engineer, Energy Systems Development, EERC, UND.

- Worked closely with EERC management team to develop new programmatic directions to solve challenges in the energy industry.
- Managed projects in areas of gasification, CO_2 capture, supercritical CO_2 power cycles, and systems engineering.

2008–2015: Research Manager, EERC, UND.

- Managed projects in areas of gasification, gas cleanup, hydrogen production, liquid fuel production, and systems engineering.

2005–2008: Research Engineer, EERC, UND.

- Areas of focus included mercury control technologies and coal gasification.
- Responsibilities involved project management and aiding in completion of projects.
- Duties included design and construction of bench- and pilot-scale equipment, performing experimental design, data collection, data analysis, and report preparation.

- Also worked in the areas of low-rank coal gasification, warm-gas cleanup, and liquid fuels production modeling using Aspen Plus software.

2001–2005: Process Engineer, Innovex, Inc., Litchfield, Minnesota.

- Responsible for various process lines including copper plating, nickel plating, tin–lead plating, gold plating, polyimide etching, copper etching, chrome etching, and resist strip and lamination.
- Duties included all aspects of process line including quality control, documentation, final product yields, continuous process improvement, and operator training.
- Gained extensive knowledge of statistical process control and statistical start-up methodology.
- Proficient with MiniTab statistical software and utilized statistical analysis and experimental design as part of daily work.
- Designed and oversaw experiments as principal investigator; wrote technical reports and papers, including standard operating procedures and process control plans; presented project and experimental results to suppliers, customers, clients, and managers; created engineering designs and calculations; and performed hands-on mechanical work when troubleshooting process issues.
- Demonstrated ability to coordinate activities with varied entities through extensive project management and leadership experience.

1998–2000: Student Research Assistant, EERC, UND.

- Worked on wide variety of projects, including data entry and programming for Center for Air Toxic Metals® (CATM®) database, contamination cleanup program development, using aerogels for emission control, and development of nationwide mercury emission model.

Publications

Has coauthored numerous professional publications.

MICHAEL P. WARMACK
Distinguished Oil and Gas Facilities Engineer
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5004, mwarmack@undeerc.org

Education and Training
B.S., Chemical and Petroleum Refining Engineering, Colorado School of Mines, 1981.

Research and Professional Experience
2022–Present: Distinguished Oil and Gas Facilities Engineer, EERC, UND.

- Serves on EERC project teams and works with EERC clients by providing technical leadership/oversight on industrial and governmental projects relating to enhanced oil recovery (EOR) and carbon capture, utilization, and sequestration (CCUS) projects to improve development and production of domestic energy.
- Supports planning, design, selection of materials/treatment programs, costing, reporting, and/or upgrade/retrofit efforts related to production facilities optimization for unconventional oil plays; injection, production, and recycle infrastructure associated with EOR/incremental oil recovery (IOR) in conventional and unconventional oil and gas plays; infrastructure associated with capture and injection of CO_2 for geologic storage; and other emerging challenges associated with oil and gas injection/production processes.
- Has more than 40 years of experience in oil and gas production and operations, facilities design and installation, chemical treatment and optimization, and hands-on experience in multiple engineering disciplines.

2021–2022: Principal Oil and Gas Facilities Engineer, EERC, UND.

- Served on EERC project teams and worked with EERC clients to improve development and production of domestic energy.
- Supported planning, design, selection of materials/treatment programs, costing, reporting, and/or upgrade/retrofit efforts related to production facilities optimization for unconventional oil plays; injection, production, and recycle infrastructure associated with EOR/IOR in conventional and unconventional oil and gas plays; infrastructure associated with capture and injection of CO_2 for geologic storage; and other emerging challenges associated with oil and gas injection/production processes.

2015–2020: Denbury Resources, Plano, Texas.
Was directly involved with Denbury's CO_2 operations within Delhi EOR and natural gas liquids (NGL) facilities (Delhi, Louisiana) and Tinsley EOR unit (Tinsley, Mississippi). Positions held included the following:

Facilities and Optimization Engineer – Delhi EOR Unit

- Provided engineering support on operations for Delhi EOR and NGL facilities.

- Provided recommendations and designs for facility upgrades (EOR facility), new equipment installation (EOR and NGL facilities), programming changes to plant operations, and operational changes within facilities. Efforts resulted in increased operational run time of plant and field operations while providing more efficient separation through plant.
- Worked with vendor on operations of NGL plant, resulting in equipment upgrades and increasing run time of plant from 85% in 2018 to 95% in 2019.
- Initiated monthly mechanical integrity and chemical reviews of plant and field operations.
- Designed and installed oil line to third-party crude blending facility, resulting in additional revenues without costs to unit.

Facilities and Optimization Engineer – Tinsley EOR Facility

- Provided detailed engineering review and recommendations for reducing chemical treatments on injection wells and improving operations of Tinsley EOR facility. Recommendations reflected development of maximum operating rate of EOR facility in terms of momentum, culminating in $9.2 million investment to upgrade plant. After completion of plant upgrades, injection well treatments were reduced from 40+ treatments/month to ~1 per month while reducing treating chemical expenses by approximately $2.4 million per year.
- Led engineering review on reduced injection occurring in field. Provided detailed analysis on injection system resulting in recommendation to improve flow in two major distribution lines.
- Instituted monthly mechanical integrity and chemical treating reviews on field operations.

2001–2015: Chaparral Energy, Oklahoma City, Oklahoma.
Directly involved with Chaparral's EOR operations in Texas and Oklahoma Panhandle areas, northeast Oklahoma area, and primary production activities in Oklahoma and Texas Panhandle areas. Positions held included the following:

Facilities Advisor/Facilities Manager (2011–2015)

- Provided project management and engineering oversight for Chaparral's largest CO_2 development that included grassroots 68-mile CO_2 pipeline and grassroots CO_2 capture facility to serve new EOR project in northeast Oklahoma.
- Directly responsible for facility design and integration within all of Chaparral's ongoing and developing EOR projects, resulting in alternative design of field facilities to replace underperforming equipment.
- Initiated standardization of facility designs within EOR projects for compression, water facilities, CO_2 pumps, and cooling facilities.
- Directly involved with developing and maintaining Chaparral's EOR budget, including full field project development costs.
- Recognized as key contributing team member by leading Chaparral in achieving its initial and highest monthly oil production level of 1 MMBO in May 2014.

Operations Manager/Operations Engineer (2001–2011)

- Directly responsible for development of Chaparral's CO_2 expansion programs within active and three new EOR projects within Oklahoma and Texas Panhandle areas. Development work included well intervention, facilities design and installation, chemical reviews on ongoing operations, drilling, and completion programs, WAG design and implementation, and land work support. Chaparral's CO_2 expansion programs realized increase in gross production of over 5100 BOPD from nits involved.

- Directly responsible for securing CO_2 sourcing from Arkalon ethanol plant in Liberal, Kansas, resulting in development of grassroots CO_2 capture facility adjacent to ethanol plant.
- Directly responsible for development, installation, and monitoring of three pipeline projects in southwest Kansas and Oklahoma and Texas Panhandle areas to service new CO_2 projects.
- Instituted chemical squeeze treatment on submersible pump installations to stem scaling of downhome equipment. Treatments resulted in increasing run time of submersible pumps from less than 3 months to 18 months.
- Recognized by Chaparral as key personnel asset within its EOR operations during Chaparral's financial presentations.

1999–2001: WoodGroup ESP, Oklahoma City and Purcell, Oklahoma.
Alliance Manager (2000–2001)

- Directly responsible for alliance with Kerr McGee for submersible pump installation and operation.
- Instituted new design parameters on submersible pump installations that dramatically increased run time of installed equipment. This design resulted in savings of over $1 million per year to Kerr McGee. Recognized by Kerr McGee for savings to its operations.
- Developed plan for continuous improvement concerning submersible pump installations based upon review of equipment installations and cooperation of WoodGroup's personnel and Kerr McGee's Failure Analysis Team.

Reliability Engineer (1999–2000)

- Directly responsible for investigation into failures on domestic and international customer equipment. Provided summary reports of findings with proposed solutions to prevent future reoccurrence.
- Directly responsible for investigative review on WoodGroup's operating standards, equipment upgrades, and modifications.
- Provided engineering support to in-house quality control on procured and manufactured equipment.

1997–1998: Lead Field Engineer, Occidental Petroleum, Maracaibo, Venezuela.

- Supervised staff of up to 15 field personnel engaged in completions, nondrilling workovers, and downhole operations.
- Coordinated fieldwork with Maracaibo office and camp personnel for workover and production operations, submersible equipment design and installation, and workover rig movements.
- Recognized as key asset in ongoing operations through sale of operations from Occidental to Union Texas Petroleum to Arco and British Petroleum.

1981–1997: Occidental Petroleum and prior subsidiaries, Oklahoma City, Oklahoma.

- Directly involved with ongoing EOR projects in central Oklahoma area that included design of grassroots EOR project in acquired unit for plant and field facilities. Instituted new design for CO_2 distribution system within field.
- Implemented Failure Analysis Team (FAT Team) to extend run time of submersible pump installations within company's EOR operations. FAT Team consisted of operating personnel, a chemical supplier, and a submersible pump supplier. Work from FAT Team resulted in extending run times of submersible pumps from 15 months to over 24 months within 2 years, resulting in reduced operating and equipment costs.
- Led successful acquisition efforts on two producing properties valued at $3.0 million. Directly involved with unsuccessful acquisition of two companies.

- Continuously enhanced production base from wells ranging in depths from 3000 to 15,000 feet through workover programs, recompletions, stimulations, and changes in artificial lift equipment. Developed and instituted program for having pipeline connection installed prior to frac treatments, resulting in better completions and higher production from wells.
- Developed multistage frac design in vertical wells using bullet perforations, reducing frac time by 50% and resulting in savings of over $250,000 per job.
- Selected by Oxy to serve on worldwide ESP team to enhance run time and use of ESP equipment.

Publications

Has coauthored numerous professional publications.

MICHELLE R. OLDERBAK
Senior Project Management Specialist
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5145, molderbak@undeerc.org

Education and Training

A.A.S. (Administrative Secretary), Northwest Technical College, East Grand Forks, 1995.

Research and Professional Experience

2006–Present: Senior Project Management Specialist, EERC, UND.

- Serves as liaison between Director of Energy Systems Development, Associate Vice President for Research, several principal engineers, and associated internal EERC personnel as well as with external clients and associates.
- Assists project managers and their groups in preparation of program plans, proposals, and topical and periodical reports.
- Initiates procedures for efficient operation and work flow among research supervisors, managers, and clerical workers.
- Establishes and maintains Director of Energy Systems Development's administrative filing system.
- Coordinates meetings and travel arrangements.
- Performs extensive administrative support activities.
- Coordinates Director of Energy System Development's projects at all levels and facilitates communication with group.

Principal areas of interest and expertise include data reduction and interpretation as well as data presentation for report preparation.

2000–2006: Technical Research Assistant, Environmental Technologies Research Division, EERC, UND.

- Performed data collection, organization, tracking, and storage.
- Performed preliminary data reduction and interpretation as well as presentation for report preparation.
- Provided first review of draft reports, including organizing data, editing, and proof-reading for format and content.
- Performed administrative duties, including coordinating Senior Research Manager's projects at all levels and facilitating communication among Environmental Technologies group members.

1997–2000: Research Information Associate, Environmental Technologies Research Division, EERC, UND.

- Served as liaison between Senior Research Manager and internal EERC personnel as well as with clients and associates worldwide.
- Assisted project manager and group in preparation of program plans, proposals, and topical and periodical reports.
- Produced charts, graphs, and data displays by obtaining, compiling, and presenting information in an appropriate format.

- Initiated procedures for efficient operation and work flow among research supervisors, managers, and clerical workers.
- Established and maintained Senior Research Manager's administrative filing system.
- Coordinated meetings and travel arrangements.
- Performed general administrative support activities for entire group.

1996–1997: Research Information Associate, Administrative Resources, EERC, UND.

- Interacted with professional staff and performed variety of duties to meet deadlines for researchers and other personnel.
- Worked with Editing, Graphics, and Workflow Coordinator to produce internal and external correspondence.
- Formatted and produced state and federal forms, technical reports, proposals, and other documents.
- Assisted in gathering and coordinating graphics, slide content, and other technical information.

Publications

Has coauthored several professional publications.

ORGANIZATION QUALIFICATIONS

- **Energy & Environmental Research Center (EERC)** – The EERC is recognized as one of the world's leading developers of cleaner, more efficient energy to power the world and environmental technologies to protect and clean our air, water, and soil. Our mission is to provide practical, pioneering solutions to the world's energy and environmental challenges. Our team of more than 280 scientists, engineers, and finance, operations, and other support professionals work together to develop practical solutions to critical global issues. Our comprehensive research portfolio comprises a wide array of services tailored to meet each client's needs. We have worked with more than 1300 clients in 53 countries worldwide from Fortune 500s to small start-ups. Trusted, dynamic working relationships with industry, government, and research organizations provide the foundation for bringing cutting-edge science and engineering technologies together to resolve critical global challenges.

- **Hess Corporation** – Hess has operated in North Dakota continuously since 1951 and is one of the state's largest oil and gas producers. Hess operates upstream and midstream facilities both north and south of Lake Sakakawea, which includes over 3000 miles of gathering pipelines for oil, gas, and produced water. The referenced gathering systems were installed over a wide range of years and are constructed of various materials from carbon steel, polypropylene, fiberglass, and FlexSteel. Hess is proactively researching alternative technologies that can be used to economically provide early leak detection and that will aid in determining the integrity of its in-service gathering systems.

- **Oneok, Inc.** – Oneok is a leading midstream service provider and owner of one of the nation's premier natural gas liquids (NGLs) systems, connecting NGL supply in the Rocky Mountain, Mid-Continent, and Permian regions with key market centers and an extensive network of natural gas gathering, processing, storage, and transportation assets. Oneok is a Fortune 500 company headquartered in Tulsa, Oklahoma, and is included in the S&P 500.

- **Energy Transfer** – Energy Transfer is celebrating 25 years as the U.S. midstream energy leader. Cofounded in 1996 by Kelcy Warren and Ray Davis, Energy Transfer is now one of the most diversified, publicly traded energy infrastructure partnerships in the country, with more than 90,000 miles of pipeline and associated infrastructure traversing 38 states and Canada, international offices in Canada and Beijing, and nearly 10,000 employees. Energy Transfer Partners operates an 1195-mile system, including the Dakota Access and ETCO pipelines, that enables up to 1.1 million barrels per day to be safety transported from North Dakota's Bakken and Three Forks Formations.

- **TC Energy Corporation** – For more than 70 years, TC Energy has operated pipelines, storage facilities, and power generation plants that support in Canada, the United States, and Mexico. Its facilities operate safely, reliably, and quietly. Core operations include carbon-free energy solutions, 57,900 miles of natural gas pipeline, 653 billion cubic feet of natural gas storage, 3000 miles of hydrocarbon liquids pipelines, and seven power generation facilities with a capacity of 4200 megawatts. Its corporate office is headquartered in Calgary, Alberta.

- **Marathon Petroleum Logistics (MPLx)** – MPLx is a diversified, large-cap master limited partnership formed by Marathon Petroleum Corporation (MPC) that owns and operates midstream energy infrastructure and logistics assets and provides fuels distribution services. MPLx's assets include a

network of crude oil and refined product pipelines; an inland marine business; light-product terminals; storage caverns; refinery tanks, docks, loading racks, and associated piping; and crude and light-product marine terminals. The company also owns crude oil and natural gas gathering systems and pipelines as well as natural gas and NGL processing and fractionation facilities in key U.S. supply basins. Its headquarters are in Findlay, Ohio.

APPENDIX E

BUDGET NOTES

BUDGET NOTES

ENERGY & ENVIRONMENTAL RESEARCH CENTER (EERC)

BACKGROUND

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

INTELLECTUAL PROPERTY

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

BUDGET INFORMATION

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

Escalation of labor and EERC recharge center rates are 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.

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.

Technology Selection Subcontracts: Technology selection subcontracts are funds provided to companies that are selected by the intelligent Pipeline Integrity Program (iPIPE) 3.0 technology selection committee. The EERC will subcontract to the designated companies.

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

Food: Expenditures for project partner meetings where the primary purpose is dissemination of technical information may include the cost of food. EERC employees in attendance will not receive per diem reimbursement for meals that are paid for by project funds. The estimated cost is based on the number and location of project partner meetings.

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.

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, website design, brochures, and photographs. The estimated cost is based on prior experience with similar projects.

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.

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

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

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

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

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