

Ms. Karlene Fine
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 Ms. Fine:

Subject: EERC Proposal No. 2016-0070 Entitled “Expansion of EERC’s Gathering Pipeline Leak Detection Demonstration Project” in Response to a Request from the North Dakota Industrial Commission Oil and Gas Research Program

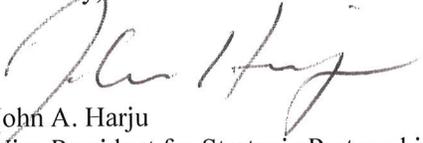
The Energy & Environmental Research Center (EERC) is pleased to propose a project expansion of the previously awarded “Produced Fluids Gathering Pipeline Study.” This expansion of the original project is designed to address state priorities that have arisen since the original study scope was determined in May 2015. The project expansion will accomplish two tasks deemed important to the state of North Dakota:

1. Create and populate a Web-based database to facilitate matches between commercially available and emerging pipeline technology and the needs of liquids gathering pipeline operators in North Dakota in an effort to decrease pipeline leak incidents, volumes, and impacts.
2. Include an additional, newly identified industrial partner and leak detection technology in the already-under-way pipeline leak detection system demonstration project.

Enclosed please find an original and one copy of the subject proposal along with a check for \$100. 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) 777-5157, by fax at (701) 777-5181, or by e-mail at jharju@undeerc.org.

Sincerely,



John A. Harju
Vice President for Strategic Partnerships



Thomas A. Erickson, CEO
Energy & Environmental Research Center

JAH/hmv

Enclosures

c/enc: Brent Brannan, Oil and Gas Research Council

Oil and Gas Research Program

North Dakota

Industrial Commission

Application

Project Title: Expansion of EERC's Gathering Pipeline Leak Detection Demonstration Project

Applicant: Energy & Environmental Research Center

Principal Investigator: Jay Almlie

Date of Application: March 2016

Amount of Request: \$248,559

Total Amt. of Proposed Project: \$248,559

Duration of Project: 15 months

Point of Contact (POC): John A. Harju

POC Telephone: (701) 777-5157

POC E-Mail Address: jharju@undeerc.org

POC Address:

15 North 23rd Street, Stop 9018

Grand Forks, ND 58202-9018

TABLE OF CONTENTS

Abstract	4
Project Description	5
Standards of Success	10
Background/Qualifications	10
Management	10
Timetable	11
Budget	11
Confidential Information	12
Patents/Rights to Technical Data	12
Status of Ongoing Projects	12
Resumes of Key Personnel	Appendix A
Budget Justification	Appendix B

ABSTRACT

Objective: The Energy & Environmental Research Center (EERC) proposes a project to expand the original scope of the previously awarded and legislatively directed “Produced Fluids Gathering Pipeline Study.” This expansion will address state priorities that have arisen since the original study was scoped in May 2015. The project expansion will accomplish two tasks deemed important to the state of North Dakota: 1) create and populate a Web-based database to facilitate matches between commercially available pipeline technology and the needs of liquids gathering pipeline operators in North Dakota and 2) include an additional, newly identified industrial partners and leak detection technology in the already-under-way pipeline leak detection system demonstration project.

The goal of this project expansion is to bridge the gap in understanding between capabilities claimed by vendors of pipeline technology and true operational needs of gathering pipeline operators. This goal will be supported by the following objectives: a) construct a Web-based database, b) solicit technical data from vendors, c) populate the database, d) make the database available to state and industry entities to use as a technology selection tool, and e) expand the scope of the existing pipeline demonstration to include an additional pipeline operator partner and an additional developmental pipeline leak detection technology.

Expected Results: The results of the proposed work will encourage and facilitate adoption of commercially available and emerging technologies by liquids gathering pipeline operators in North Dakota to attain improvements in leak/spill incidents, volumes, and environmental impacts. As a secondary benefit, the project will also serve to inform policy makers on technical issues related to suitability (or unsuitability) of various technologies to specific applications on liquids gathering pipeline designs, thus helping to better understand the claims made by many vendors in this space.

Duration: The duration of the proposed project is 15 months (May 1, 2016, to July 31, 2017) but may be extended if database maintenance funding is made available through other venues (such as commercial support). The EERC does not intend to solicit additional funds from the North Dakota Industrial Commission Oil and Gas Research Program (OGRP) to continue database maintenance beyond July 2017.

Total Project Cost: The total cost of the project expansion is \$248,559. The amount requested from OGRC is \$248,559. In accordance with the originally legislated effort, cost share is not required.

Participants: Proposed participants include the EERC, OGRP, vendors, and an additional pipeline operator/host.

PROJECT DESCRIPTION

In April 2015, the North Dakota Legislature passed House Bill (HB) 1358 directing the EERC, in partnership with the North Dakota Industrial Commission (NDIC) Oil and Gas Research Council (OGRC), to initiate a study to evaluate and assess potential improvements to the performance of produced water and crude oil pipelines in North Dakota. The first phase of this directed work resulted in a comprehensive report on produced liquids gathering lines in North Dakota. The report summarized the state of gathering pipelines in North Dakota, made detailed comparisons between spill statistics and regulations on pipelines in North Dakota versus other states, provided detailed background on pipeline technology including leak detection technology, and made 23 recommendations to state regulators and industry that are intended to guide potential improvements to gathering pipeline regulation and safe operation.

The second phase of this directed work, now under way, will demonstrate industry's best approaches to leak detection technology applied to gathering pipeline systems. As part of this second phase, the EERC recruited three pipeline operating partners to host demonstrations of technology on their gathering pipeline systems. Although several potential partners expressed interest, the number of partners was limited by the available budget. The EERC's role is to define objective test procedures to evaluate the performance of various technologies on partners' pipelines, monitor those tests, collect and analyze performance data from the tests, collect and analyze cost data on demonstrated leak detection systems, and report conclusions to the state of North Dakota.

During these phases of work associated with the tasks assigned by HB1358, the state of North Dakota further expanded its existing interest in this topic to include a desire to catalog available and emerging technologies applicable to gathering pipelines and to expand the liquids gathering pipeline leak detection system demonstration to include an even broader variety of approaches to gathering pipeline leak detection. It is with this knowledge that the Energy & Environmental Research Center (EERC) proposes a project to expand the original scope of the previously awarded "Produced Fluids Gathering Pipeline Study" to include a third phase of work. This expansion of the original project is designed to address state priorities that have arisen since the original study was scoped in May 2015.

The project expansion will accomplish two tasks deemed important to the state of North Dakota: 1) create and populate a Web-based database to facilitate matches between commercially available pipeline technology and the needs of liquids gathering pipeline operators in North Dakota and 2) include an additional, newly identified industrial partners and leak detection technology in the already-under-way pipeline leak detection system demonstration project.

The first major activity of this proposed project expansion will create and maintain a pipeline technology database that is intended to serve as a clearinghouse of information on technologies that may improve the safety, reliability, and performance of pipelines in North Dakota. A primary function of this database is to create a single “point of contact” for information sharing. This database will be populated with a broad array of data necessary to determine the compatibility of each submitted technology with operational demands of liquids gathering pipelines in North Dakota. Environmental operating ranges, detection limits, sensitivity information, communication infrastructure requirements, retrofitability characteristics, compatibility with fluid types, and compatibility with various pipeline materials will all be addressed in the database to assist in selection of appropriate technologies for specific pipeline designs. This effort will not include validation and testing of any submitted technologies. Technologies housed within the database will fall into several categories, including measurement, leak detection (internal or external), pipeline materials, construction/installation materials, communications, inspection equipment, and others. This database will be loosely modeled on the widely acclaimed and analogous Gas-Flaring Reduction Technologies database previously designed by the EERC.

The second major activity of this proposed project expansion will work to incorporate a fourth industrial partner and an additional leak detection technology into the ongoing EERC liquids gathering pipeline leak detection pilot demonstration project. A fourth partner has approached the EERC to be included in the demonstration, but because scopes of work had already been defined with three other industrial partners, the EERC does not have available budget to accommodate the fourth partner and additional technology demonstration. The fourth industrial partner has proposed demonstration of a unique leak detection technology that employs an annular space within a widely used type of composite pipeline to potentially sense certain types of pipeline integrity issues before an actual pipeline leak happens on a particular produced water gathering pipeline operated by the industrial partner. A summary of the existing three demonstration targets and the proposed fourth target are presented in Table 1.

Table 1. Summary of Existing and Proposed Partners in Pipeline Leak Detection Demonstration

	Sector	Fluid Carried	Pipeline Material	Leak Detection Technology
Partner A (existing)	Oil producer	Produced water	Fiberglass	In-house computational pipeline modeling (CPM)
Partner B (existing)	Pipeline operator	Produced water	High-density polyethylene	In-house CPM vs. third party CPM
Partner C (existing)	Oil producer	Crude oil	Steel	To be determined (eagerness to apply multitude of technologies)
Partner D (proposed)	Pipeline operator	Produced water	Flexsteel	In-house CPM + annular space leak detection in a composite pipeline

Goals and Objectives:

The goal of this project expansion is to bridge the gap in understanding between capabilities claimed by vendors of pipeline technology and true operational needs of gathering pipeline operators. This goal will be supported by the following objectives: a) construct a Web-based database, b) solicit technical data from vendors, c) populate the database, d) make the database available to state and industry entities to use as a technology selection tool, and e) expand the scope of the existing pipeline demonstration to include an additional pipeline operator partner and an additional developmental pipeline leak detection technology.

Methodology:

Task 1 – Database Design, Creation, and Testing (Months 1–3)

- Define categories of pipeline technologies for which vendor data will be solicited. An initial sampling of categories includes the following:
 - Leak detection systems
 - External leak detection
 - Internal leak detection
 - Pipeline materials
 - Construction/installation materials (e.g., locator wire, marking tape, geotech membrane, bedding material, etc.)
 - Instrumentation
 - Communication systems and equipment
 - Inspection systems and equipment
- Create a list of specific technical information that will be requested for technologies in each category.

Task 2 – Pipeline Technology Request for Information (Months 1–3)

- Building upon the recently completed pipeline study, the EERC will create a Request for Information (RFI) that describes the critical issues impacting pipeline use in North Dakota and requests that technology providers contact the EERC.
- To supplement this RFI, a set of PowerPoint slides will be created to summarize pipeline statistics, critical factors impacting North Dakota pipeline operation, and provide instructions on submitting information to the database. The EERC learned from its experience with the flaring mitigation database that many vendors lack adequate education and technical information on the market to which they wish to apply their products. The intent of these summary slides is to provide all vendors with a

common understanding of liquids gathering pipelines in North Dakota and the environmental variables associated with operation of these pipelines in North Dakota.

Task 3 – Initial Outreach to Vendors (Months 4–11)

- Upon completion of the database and RFI, the EERC will do an initial round of outreach, requesting that companies with pipeline technologies submit information to the database. Initial outreach will focus on companies participating in the pipeline study. Ongoing outreach is anticipated, but after the stated period of performance, this outreach will be considered outside the scope of this proposed effort.

Sustained Database Management and Outreach (future funding)

- Ongoing support of the database, outreach to pipeline technology providers, and coordination with midstream operators are expected to continue for several years after completing the above-proposed work. Based on experience with the ongoing flaring solutions database, the EERC anticipates costs of \$100–\$200K/yr, depending upon the level of interest in the database. Continuing support will be sought from industry. The EERC does not currently expect to solicit continuing support from OGRP for this effort.

Task 4 – Inclusion of Annular Space Pipeline Leak Detection System into Pipeline Leak Detection Pilot Demonstration Project (Months 1–8)

The EERC will work with the identified industrial pipeline operator to specify a scope of work comparable to that negotiated with three other demonstration partners, but specifically to include objective evaluation of the annular space technology. Demonstration procedures will be jointly developed between the EERC and the pipeline operator, with potential input from the pipeline vendor touting the leak detection capabilities of their pipeline material. A demonstration schedule will also be negotiated. As with other demonstration partners, the EERC will report results to OGRC and NDIC at the conclusion of the demonstration (late fall 2016). Results will compare costs and performance of various approaches to liquid pipeline leak detection systems and will provide the state of North Dakota with data to guide expectations for such systems.

Anticipated Results:

The results of the proposed work will encourage and facilitate adoption of commercially available technologies by liquids gathering pipeline operators in North Dakota to attain improvements in leak/spill incidents, volumes, and environmental impacts. As a secondary benefit, the project will also serve to inform state policymakers on technical issues related to suitability (or unsuitability) of various technologies

to specific applications on liquids gathering pipeline designs, thus helping to better understand the claims made by many vendors in this space.

Facilities, Resources, and Techniques to Be Used:

The EERC will host the Web-based database on its own servers. Data will be publicly available to view. Data input will be accomplished by technology vendors, with the assistance of the EERC.

The liquid gathering pipeline leak detection pilot demonstration will employ a working pipeline owned and operated by the volunteer industrial partner. Therefore, the EERC will rely upon partner staff to operate the pipeline while simultaneously achieving the objectives of the demonstration tests.

Environmental and Economic Impacts While Project Is Under Way:

None.

Ultimate Technological and Economic Impacts:

Ultimately, it is anticipated that the database will facilitate adoption of appropriate technologies to liquids gathering line systems in North Dakota and will decrease the economic and environmental impacts of liquid spills and leaks. As a secondary benefit, it will also serve as a central collection point for all technologies, thus decreasing the research time invested by both industry and state leadership on these technologies and providing a marketing outlet for technology providers.

The results of the pipeline leak detection pilot demonstration project will serve to calibrate expectations of leak detection systems (performance and cost) applied to liquids gathering pipelines, and thus serve to more rapidly encourage appropriate use of these systems to limit liquid leaks from the vast networks of gathering pipelines in North Dakota. This will have direct impacts on the economics of liquids gathering and, therefore, on oil production in general.

Why the Project Is Needed:

State leaders are regularly approached by vendors claiming to offer a solution to the problem of liquids gathering pipeline leaks in the state. It is challenging for these leaders, not in the business of pipeline design, to discern valid vendor claims from those with less credible foundation. The proposed effort will help to deliver that information to industry and state entities alike and will facilitate objective comparisons. Industry will also benefit from use of these data. The potential application of new technologies to small gathering lines may, in many cases, be unknown to industry. Similarly, the demands of these applications are largely unknown to vendors, as vendors have traditionally focused on larger transmission lines. Gathering lines represent a new market to many vendors of promising and evolving pipeline technologies, including leak detection systems.

STANDARDS OF SUCCESS

Success will be achieved when a notable increase in technology adoption into the liquids gathering pipeline market is achieved. Presumably, this technology adoption will lead to decreased pipeline spill incidents, volumes, and impacts.

Deliverables:

1. Quarterly reports to OGRP highlighting results of ongoing database development and data population activities.
2. A publicly viewable database containing relevant technologies submitted by vendors.
3. An additional section on a previously unreported technology in the final report on the Liquids Gathering Pipeline Leak Detection Pilot Demonstration project.
4. A final report to OGRP summarizing project achievements.

BACKGROUND/QUALIFICATIONS

Personnel:

Resumes of key personnel are provided in Appendix A. John Harju, EERC Vice President for Strategic Partnerships, will serve as project advisor. Jay Almlie, EERC Principal Engineer, will serve as project manager and principal investigator (PI).

Energy & Environmental Research Center:

The EERC is a high-tech, nonprofit branch of the University of North Dakota, exclusively conducting contract research for a multinational client base. One of the EERC's strategic areas of expertise is oil and gas, with specialized experience focusing on design and implementation of new approaches to the exploration, development, and production of oil and gas. Related ongoing projects include the Bakken Production Optimization Program, which includes tasks focused on soil remediation and land reclamation, and the North Dakota Legislature-mandated Gathering Pipeline Study. Related projects conducted in the past include studies focused on the Williston, Powder River, Denver–Julesburg, and Alberta Basins, and multiple soil and groundwater remediation efforts.

MANAGEMENT

The EERC manages over 200 active contracts a year and has had more than 1320 clients in 52 countries. Best practices are provided to EERC project managers and clients with regard to fund accounting, budget reporting, contract milestone tracking, and contract services. The deliverables of this proposal will be incorporated into a contract agreement, ensuring timely accomplishment of milestones.

Progress reports will be prepared on a quarterly basis and will serve as a means of evaluating the project with respect to budget, schedule, and technical achievement.

Project manager and PI Jay Almlie will oversee the project. He will be responsible for understanding technical details, budget details, schedule details, project coordination, guidance, and supervision to ensure consistent progress. Further, he will be responsible for communicating project and task progress to NDIC OGRC on a regular basis via reports and in-person meetings.

TIMETABLE

This project is proposed as a 15-month project beginning on May 1, 2016, and ending on July 31, 2017. Figure 1 summarizes the project timetable.

Task	2016								2017						
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15
	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Project Management	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Semiannual OGRC Briefings	★					★						★			
Quarterly Reports to OGRC				★			★			★					
Task 1 - Database Design, Creation, and Testing	■	■	■												
Task 2 - Pipeline Technology Request for Information	■	■	■												
Task 3 - Initial Outreach to Vendors				■	■	■	■	■	■	■	■	■			
Task 4 - Pipeline LDS Addition	■	■	■	■	■	■	■	■							
Pipeline Demonstration Final Reporting						■	■	■							
Pipeline Demonstration Final Report Due									★						
Final Reporting on Database											■	■			
Final Database Report Due													★		
Database Maintenance													■	■	■

Figure 1. Preliminary project timetable.

BUDGET

The total cost of the project and the amount requested from OGRC is \$248,559. Additional funding will be sought from industry to maintain the database after the initial 12-month period of performance. In any event, the database will be housed and available on EERC’s Web site through 2018.

CATEGORY	BUDGET
Total Labor	\$ 216,485
Travel	\$ 8,818
Supplies	\$ 753
Other*	\$ 2,625
Laboratory Fees & Services	
Graphics Service	\$ 626
Research Information Service	\$ 19,252
Total Project Cost – U.S. Dollars	<u>\$ 248,559</u>

*May include costs such as food, printing, communications, or other miscellaneous expenses.

CONFIDENTIAL INFORMATION

There is no confidential information included in this proposal.

PATENTS/RIGHTS TO TECHNICAL DATA

No patentable technologies are expected to be created during this work.

STATUS OF ONGOING PROJECTS

The EERC has previously been awarded OGRC funding for several different projects. Active projects include the Plains CO₂ Reduction Partnership; the Program to Determine the Uniqueness of the Three Forks Bench Reserves, Determine Optimal Well Density in the Bakken Pool, and Optimize Bakken Production (also known as the Bakken Production Optimization Program, or BPOP); the project known as the Oil Characterization Study; and the Produced Fluids Gathering Pipeline Study (commissioned by the 64th North Dakota Legislative Assembly). The status of those projects is presented below:

1. G-015-030 “Plains CO₂ Reduction (PCOR) Partnership Program – Phase III”
 - OGRC funding: \$500,000; total project cost: \$116,760,635.
 - Period of performance: October 1, 2007 – September 30, 2017.
 - The PCOR Partnership is one of seven regional partnerships awarded in 2003 by the U.S. Department of Energy’s National Energy Technology Laboratory to determine the best approaches for the geologic storage of CO₂ as well as safely and permanently demonstrate this technique. Currently in its eighth year of the demonstration phase, the PCOR Partnership is testing the validity of different characterization, modeling and simulation, risk assessment, and monitoring techniques and technologies at its Bell Creek and Aquistore demonstration projects.

2. G-030-060 “Program to Determine the Uniqueness of Three Forks Bench Reserves, Determine Optimal Well Density in the Bakken Pool, and Optimize Bakken Production” (also known as BPOP)
 - OGRC funding: \$8,554,500 (includes \$6.26M subcontract to Continental Resources); total project expected cost: \$116,834,500 (includes \$106M in-kind from Continental Resources).
 - Period of performance: June 1, 2013 – June 30, 2016.
 - This a 3-year program led by the EERC, in close coordination with Continental Resources, Inc., and several of the Williston Basin’s premier operating companies. The goal of this program is to simultaneously improve Bakken system oil recovery while reducing its environmental footprint. This program is investigating new technologies and approaches to simultaneously increase the understanding of potential petroleum reserves in the Bakken/ Three Forks system and decrease recovery costs in an environmentally sound manner. Now 2 years into the program, the EERC has been heavily involved in headline topics of flaring reduction, TENORM (technologically enhanced naturally occurring radioactive material) disposal, saline and hydrocarbon spills remediation, and crude oil characterization as it applies to transport by rail.
3. G-Sandia 01 “Oil Characterization Study”
 - OGRC funding: \$150,000. This study is complementary to funding of \$108,000 provided to the EERC by Sandia National Laboratories.
 - Period of performance: February 1, 2015 – June 30, 2016.
 - This project is intended to assess oil properties relative to its safe storage and transport. The EERC, in collaboration with Sandia National Laboratories, has completed a literature review of available data on crude oil properties and prepared a draft sampling, analysis, and experimental plan that forms the basis for subsequent Phase II crude oil characterization activities.
4. G-Produced Water Pipeline 02 “Produced Fluids Gathering Pipeline Study,” commissioned by the 64th North Dakota Legislative Assembly
 - OGRC funding: \$1,500,000.
 - Period of performance: April 20, 2015 – June 30, 2017.
 - This project focuses on conducting an analysis of crude oil and produced water pipelines, including construction standards, depths, pressures, monitoring systems, maintenance, types of materials used in the pipeline backfill, and analysis of the ratio of spills and leaks

occurring in this state in comparison to other large oil- and gas-producing states with substantial volumes of produced water. The EERC will analyze the existing regulations on construction and monitoring of crude oil and produced water pipelines, determine the feasibility and cost-effectiveness of requiring leak detection and monitoring technology on new and existing pipeline systems, and provide a report with recommendations to the NDIC and the Energy Development and Transmission Committee by December 1, 2015.

APPENDIX A
RESUMES OF KEY PERSONNEL



JOHN A. HARJU

Vice President for Strategic Partnerships

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

15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA

Phone: (701) 777-5157, Fax: (701) 777-5181, E-Mail: jharju@undeerc.org

Principal Areas of Expertise

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

Qualifications

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

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

Professional Experience

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

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

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

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

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

1997–2002: Gas Research Institute (GRI) (now Gas Technology Institute [GTI]), Chicago, Illinois.

2000–2002: Principal Scientist, Produced Water Management. Mr. Harju’s responsibilities included development and deployment of produced water management technologies and methodologies for cost-effective and environmentally responsible management of oil and gas produced water.

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

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

1997: Associate Technology Manager, Soil and Water Quality.

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

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

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

1994: Research Manager.

1990–1994: Hydrogeologist.

1989–1990: Research Specialist.

1988–1989: Laboratory Technician.

Synergistic Activities

Member, National Petroleum Council

Outgoing Chairman, Interstate Oil & Gas Compact Commission, Chairman, Energy Resources, Research and Technology Committee

Member, U.S. Department of Energy Unconventional Resources Technology Advisory Committee

Member, Rocky Mountain Association of Geologists

Publications and Presentations

Has authored and coauthored more than 100 publications.



JAY C. ALMLIE

Principal Engineer, Mid/Downstream Oil & Gas Group Lead
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
Phone: (701) 777-5260, Fax: (701) 777-5181, E-Mail: jalmlie@undeerc.org

Principal Areas of Expertise

Mr. Almlie's principal areas of interest and expertise include oil and gas production optimization, oilfield NORM (naturally occurring radioactive material) waste management, hydrogen generation, data acquisition and control systems, pipeline transport, and program/project management.

Qualifications

B.S., Mechanical Engineering, and B.S., Engineering Management, University of North Dakota, 1995.

Proficient in the use of LabView, AutoCad, Autodesk Inventor, MS Excel, MS Project, MathCAD, Rockwell Software RSLogix, and RSView Studio.

Professional Experience

2009–Present: Principal Engineer, Mid/Downstream Oil & Gas Group Lead, EERC, UND. Mr. Almlie's responsibilities include supervision and direction of a diverse group of researchers focused on oil and gas production optimization, pipeline transport, emission control technology development, and hydrogen generation technology development. Mr. Almlie is responsible for technical, managerial, and business development aspects of this work. Mr. Almlie has managed several successful multimillion-dollar projects during his tenure in this position.

2006–2009: Research Manager, Environmental Technologies, EERC, UND. Mr. Almlie's responsibilities included supervising a team of researchers focused on mercury emission control, particulate matter emission control, and hydrogen production. Mr. Almlie was also involved technically in projects in each of these areas.

2002–2006: Research Engineer, Environmental Technologies, EERC, UND. Mr. Almlie's responsibilities included projects involving mercury control, particulate matter emission control, and emission control for diesel systems.

2000–2002: Lead Mechanical Engineer–Water Systems, International Space Station Habitability Outfitting, and Deputy Project Manager, International Space Station Galley, Lockheed Martin Space Operations Company, Houston, Texas. Mr. Almlie's responsibilities included supervision of the Galley Potable Water System and Waste and Hygiene Compartment Crew Hygiene System design teams, development of system architecture and component specs, design of water system engineering development units, and thermal/fluid mechanics analysis and testing on water systems.

1995–2000: Mechanical Engineer, Hernandez Engineering, Inc. Mr. Almlie’s responsibilities included involvement in several projects:

- Lead mechanical engineer for a Space Shuttle thermal control system upgrade, including performing thermal design, analysis, and test functions and serving as project manager for the \$1 million research project. This was one of 10 projects identified by the National Research Council as leading contenders to extend the life of the Space Shuttle fleet.
- Lead mechanical engineer for water recovery systems, including designing, testing, and analyzing a potable water tank/radiation protection system for a crew habitat vehicle; and performing project management functions.
- Test engineer for the International Space Station Active Thermal Control System (ATCS), including thermal/vacuum testing on ISS Active Thermal Control components and participating in Analysis and Integration Team activities to ensure ISS Thermal Control System function on-orbit.

1994–1995: Research Assistant, School of Engineering and Mines, UND. Mr. Almlie’s responsibilities included computational fluid mechanics model generation for combustion applications using Fluent software.

Summer 1994: Engineering Intern, Orbital Sciences Corporation, Inc., Dulles, Virginia. Mr. Almlie’s responsibilities included performing launch vehicle dynamic separation analyses, designing payload separation system components, performing multiple stress/strain analyses on payload carrier structures.

1991–1993: Mechanical Engineering Cooperative Education Intern, Eagle Engineering, Inc., Houston, Texas. Mr. Almlie’s responsibilities included authoring a satellite ground tracking code, coauthoring a payload separation simulation code, and performing payload fairing separation analysis for Orbital Sciences Corporation’s Pegasus rocket.

Publications and Presentations

Has coauthored several professional publications.

Patents and Technology Disclosures

Radiation Shield Water Tank: Microgravity Water Tank with Capillary Air/Liquid Separation Used for Radiation Shielding. June 6, 2005. NASA Technology Disclosure.

Water Membrane Evaporator. July 22, 2005. NASA Technology Disclosure.

Miller, S.J.; Zhuang, Y.; Almlie, J.C. Advanced Particulate Matter Control Apparatus and Methods. U.S. Patent 8,092,768 B2, Jan 10, 2012.

Miller, S.J.; Almlie, J.C. Removal of Residual Particulate Matter from Filter Media. U.S. Patent 8,882,926, Nov 11, 2014.

APPENDIX B
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.

Labor: Estimated labor includes direct salaries and fringe benefits. Salary estimates are based on the scope of work and prior experience on projects of similar scope. Salary costs incurred are based on direct hourly effort on the project. Fringe benefits consist of two components which are budgeted as 66% 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. The following table represents a breakdown by labor category and hours for technical staff for the proposed effort.

Labor Categories	Labor Hours
Research Scientists/Engineers	1,191
Research Technicians	92
Senior Management	37
Technical Support Services	80
	<hr/> 1,400

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

Equipment: Not applicable.

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.

Subcontracts: Not applicable.

Professional Fees: Not applicable.

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

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

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

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

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

EERC recharge center rates are established annually.

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.

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

Shop and operation recharge fees are for expenses directly associated with the operation of the pilot plant, including safety training, personal safety items (protective eyeglasses, boots, gloves), and annual physicals for pilot plant personnel. The estimated cost is based on the estimated hours for pilot plant personnel.

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

Facilities and Administrative Cost: The facilities and administrative rate of 50.5% (indirect cost rate) included in this proposal is approved by the Department of Health and Human Services. Facilities and administrative cost is calculated on 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. The facilities and administrative rate has been applied to each line item presented in the budget table.