



December 1, 2008

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
ATTN: Oil and Gas Research Program
600 East Boulevard Avenue
State Capitol – Fourteenth Floor
Bismarck, ND 58505

Dear Ms. Fine:

Subject: EERC Proposal No. 2009-0107

Enclosed please find an original and one copy of the proposal entitled “Bakken Water Opportunities Assessment.” The overall goal of the proposed project is to provide industry with data and information on the technical and economic potential to recycle Bakken frac flowback water. Also enclosed is the \$100 application fee.

The EERC is committed to completing the project as described in this proposal if the Commission makes the requested grant.

If you have any questions regarding this proposal, please contact me by phone at (701) 777-5247, by fax at (701) 777-5181, or by e-mail at dstepan@undeec.org.

Sincerely,

Daniel J. Stepan
Senior Research Manager

Approved by:

Dr. Barry I. Milavetz, Interim VP for Research
Research Development and Compliance

DJS/kal

Enclosures

c/enc: Ron Ness, North Dakota Petroleum Council
John Harju, EERC
Lucia Romuld, EERC
Beth Kurz, EERC



PROPOSAL TO NORTH DAKOTA OIL AND GAS RESEARCH PROGRAM FOR THE NORTHERN GREAT PLAINS WATER CONSORTIUM – BAKKEN WATER OPPORTUNITIES ASSESSMENT

EERC Proposal No. 2009-0107

Submitted to:

Karlene Fine

**North Dakota Industrial Commission
ATTN: Oil and Gas Research Program
600 East Boulevard Avenue
State Capitol – Fourteenth Floor
Bismarck, ND 58505**

Proposal Amount: \$110,000

Submitted by:

Daniel J. Stepan
John A. Harju
Bethany A. Kurz

Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Daniel J. Stepan, Project Manager

Dr. Barry I. Milavetz, Interim VP for Research
Research Development and Compliance

December 2008

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BAKKEN WATER OPPORTUNITIES ASSESSMENT

ABSTRACT

The Energy & Environmental Research Center is developing the Northern Great Plains Water Consortium (NGPWC), a partnership between the U.S. Department of Energy (DOE) and key stakeholders representing oil and gas companies, power generation utilities, industry, municipalities, and other interested entities, to address critical water issues in the north-central United States. A primary goal of the NGPWC is to assess, develop, and demonstrate technologies and methodologies that minimize water use and reduce impacted water discharges from a range of energy technologies, including coal combustion, coal gasification, coalbed methane, and oil and natural gas production.

This proposal seeks funding to support a two-phase project under the NGPWC program. The objective of Phase 1 will be to assess the technical and economic potential of recycling frac flowback water. The successful conduct of Phase 1 activities will likely lead to Phase 2, a field demonstration of a mobile frac flowback water recycling technology at a host Bakken location. The total estimated project cost is \$230,000, of which the North Dakota Industrial Commission Oil and Gas Research Council is being asked to contribute \$25,000 for Phase 1 and \$85,000 for Phase 2 for a total of \$110,000 (48%). The remainder of the funds will be provided in the form of cash and/or cash equivalent by the North Dakota Petroleum Council and its members, the host site operator, and DOE.

The project period of performance is expected to be 1 year.

BAKKEN WATER OPPORTUNITIES ASSESSMENT

PROJECT DESCRIPTION

Introduction

Water is the most critical limiting resource throughout the world. Sufficient quantities of good quality water are needed for several competing uses, including energy production, growing and processing high-value crops, industrial manufacturing, and expanding populations. The Energy & Environmental Research Center (EERC) is developing the Northern Great Plains Water Consortium (NGPWC), a partnership between the U.S. Department of Energy (DOE) and key stakeholders representing oil and gas companies, power generation utilities, industry, municipalities, and other interested entities, to address critical water issues in the north-central United States. The primary goal of the NGPWC is to assess, develop, and demonstrate technologies and methodologies that minimize water use and reduce impacted water discharges from a range of energy technologies, including coal combustion, coal gasification, coalbed methane, and oil and natural gas production.

The NGPWC has identified a potential opportunity to economically recover and reuse water that is used in the oil field to pressurize and fracture oil-bearing formations to increase permeability and enhance the flow and recovery of oil. As much as 1.0 million gallons of freshwater is used to fracture an oil well in the Bakken Formation. This water is typically hauled to the well site in 7500- to 8000-gallon tanker trucks. Once the formation fracturing is completed, the water flows back (frac flowback) as the well is pumped. Frac flowback is typically disposed of via deep well injection. Transportation costs, particularly for long haul distances, can be excessive for both freshwater and flowback water. Treatment and reuse of frac flowback water may be an extremely attractive economic alternative to disposal via deep well injection.

Objective

The overall goal of the proposed project is to provide industry with data and information on the technical and economic potential to recycle frac flowback water. Specific Phase 1 objectives include 1) gathering

data on the current water use practices, 2) investigating flowback water quality with respect to time and location, 3) assessing current water-handling costs, 4) assessing the use of water recycling technologies and evaluating technical and economic suitability for application to Bakken Formation flowback water, 5) evaluating the current state of existing water recycling technologies, and 6) developing plans for a full-scale field evaluation at a host Bakken location. The objective of Phase 2 activities will be the field evaluation and assessment of a mobile frac flowback water recycling technology at a host Bakken location.

Methodology

Phase 1 – Frac Flowback Assessment and Project Coordination

The following seven-task outline will be used to assess the technical and economic opportunity to recycle frac flowback water in Phase 1.

Task 1 will document freshwater uses in Bakken Formation hydraulic fracturing, including the identification of water acquisition locations, any ongoing water recycling/reuse activities, and key considerations/constraints for reusing/recycling flowback water. Information on water treatment, including the addition of biocides and scale inhibitors prior to use in hydraulic fracturing will also be documented.

Flowback water characteristics will impact the water's potential for direct reuse or the degree to which it must be treated before it is suitable for reuse.

Task 2 will assess changes in flowback water quality with respect to time during the flowback as well as differences in quality with respect to location within the oil field (both geographically and geologically). Based on continued input from industry, a sampling and analysis plan will be developed. Selected samples of flowback water will be collected at selected locations and analyzed for the constituents listed in Table 1. These data will be used to develop an ion balance to ensure that significant constituents are accounted for.

Task 3 will evaluate current water-handling costs, detailing both acquisition and disposal, including transportation considerations. These data and information will establish the baseline for comparing the economics associated with frac flowback water recycling.

Table 1. Frac Flowback Water Chemical Analyses

Anions	Cations	Organics/Other
Bicarbonate	Barium	Total organic carbon
Carbonate	Calcium	pH
Chloride	Iron	Specific conductance
Sulfate	Magnesium	
	Potassium	
	Sodium	

Task 4 will examine the suitability of various water recycling technologies for application to Bakken flowback waters, considering technical capabilities as well as operation in extreme climates. Economic suitability to Bakken flowbacks will also be a key consideration.

Task 5 will assess the current state of existing mobile water recycling technologies and consist of interviewing both technology vendors and operators who are presently utilizing recycling technologies. This task will include site visits to current operating frac flowback water recycling locations in Texas’ Barnett Shale to observe equipment operation and to verify treatment capabilities.

Task 6 will develop detailed plans for the field evaluation of the most technically and economically sound mobile frac flowback water recycling process. Work on this task will only proceed beyond a go/no-go decision point should appropriate economic and environmental benefit tests be met. If the recycling of frac flowback water is not found to be economic, the Phase 2 evaluation will not be conducted. A detailed budget to accompany this plan will be submitted to the North Dakota Industrial Commission (NDIC) for its consideration as to whether or not the project should proceed into Phase 2.

Task 7 will include project coordination activities within the NGPWC Program and include presentations, education, outreach activities, and reporting. Project results will be presented to the Oil and Gas Research Council (OGRC), at NGPWC Program review meetings with DOE, and at appropriate regional and national water conferences, as well as at local town hall meetings. Presentations of this

nature are anticipated to continue throughout the current NGPWC operational period, ending December 31, 2009.

Phase 2 – Field Evaluation – Technical and Economic Assessment

Phase 2 of the proposed project will entail the deployment of a selected mobile frac flowback water recycling technology. The demonstration will include mobilization and setup of the technology at a host well site location, operation of the treatment system along with sampling and analyses to verify process performance, and transport of the treated water via hose/pipeline or other means to a nearby well location where the water will be reused in subsequent hydraulic fracturing operations. A detailed economic assessment of all aspects of frac flowback water recycling, including disposal cost associated with nonrecyclable flowback water will be conducted.

Why the Project Is Needed and Anticipated Results

Current water-handling practices for oil field hydraulic fracturing in the Bakken oil field typically involve acquisition of a freshwater supply, either from a municipal source or an underground supply of drinking water. In small communities in western North Dakota, this can have a profound effect on the available resource through potential competition with a municipal use or possible mining of water from small-channel aquifers. Recycling the water used to hydraulically fracture oil wells can have a profound effect on available resources, conserving the supply for other beneficial uses. Further, given the high transportation costs associated with water hauling and transportation costs, it may be economically advantageous to recycle the water used in hydraulic fracturing operations.

It is anticipated that the results of this project will demonstrate the technical feasibility of recycling frac flowback water using robust technology capable of operating in extreme climates. It is also anticipated that the project will provide a detailed economic assessment, documenting the cost advantages of frac flowback water recycling over traditional acquisition, use, and disposal methods. Further, the project will document tangible environmental benefits associated with frac flowback water recycling

including, but not limited to, reduced truck and trailer traffic, reduced dust, and a significant reduction in water requiring disposal.

Facilities, Resources, and Capabilities

The EERC and project partners, including oil and gas companies operating Bakken properties, have a unique combination of facilities, resources, and capabilities necessary to conduct a successful assessment and demonstration project. The EERC's 245,000 square feet of laboratory, technology demonstration, and office space, located on the University of North Dakota (UND) campus, houses state-of-the-art facilities for analysis, fabrication, and laboratory- to pilot-scale testing and verification. All facilities are available for the proposed project activities. In addition, the EERC has the facilities, equipment, and experienced personnel to undertake 1) relational database design, 2) geographic information system (GIS) programming, 3) database applications and decision support tools, and 4) predictive modeling. The project's industrial partners and collaborators have sites and facilities that will be used for sampling and analyses of flowback water samples and access to well site locations to conduct the demonstration of a mobile frac flowback water recycling technology.

Environmental and Economic Impacts While Project Is Ongoing

There are no readily identifiable adverse environmental or economic impacts while this project is under way.

Ultimate Technological and Environmental Impacts

An opportunity to economically recycle frac flowback water presents a number of technological and environmental benefits. While the use of freshwater for hydraulic fracturing is relatively small, compared to other uses such as irrigation, power plant cooling, and domestic uses, recycling the flowback water reduces the amount of freshwater consumption, conserving the resource for other beneficial uses. This is particularly important in drought-prone areas where water may become a scarce resource. The operation of oil field recycling technologies can be powered by the natural gas that might have otherwise been flared. This provides for the utilization of a resource that might otherwise not be used for beneficial

purposes. The amount of water that would require disposal via deep well injection would also be significantly reduced. Further, the use of recycling technologies would allow for recycled water to be transported via pipeline to a nearby well location for reuse in subsequent hydraulic fracturing. This would significantly reduce the amount of traffic that is presently needed to haul both freshwater and flowback water. This will ultimately reduce road maintenance, reduce dust and other airborne particulates resulting from transportation, and conserve fuel.

STANDARDS OF SUCCESS

The overall success of this project will be measured through the successful field demonstration of a mobile frac flowback water recycling technology that will lead to oil field deployment and economic utilization of frac flowback water recycling opportunities. There is tremendous **Value to North Dakota** through numerous and significant environmental benefits, including freshwater conservation, reduced transportation requirements, and reduced water disposal requirements. The project will contribute significantly to a vibrant oil and gas industry, critical to long-term economic success in North Dakota. It will also provide for additional employment of skilled water treatment professionals.

BACKGROUND/QUALIFICATIONS

The proposed project will be a part of one of the EERC's programs related to energy–water sustainability, the NGPWC – a cornerstone program of EERC's Water Management Center (WMC). The staff of the WMC has over two decades of hands-on experience in the assessment, testing, development, and demonstration of a wide range of water and wastewater treatment technologies. These include the use of physical, chemical, and/or biological methods for the evaluation of established treatment technologies, as well as the development of innovative treatment technologies. EERC personnel also provide technical support and evaluation of client technologies, assisting in continued development and demonstration for commercialization. Projects are routinely complemented by analytical support from the Analytical Research Laboratory and microbiological analytical support from the Environmental Microbiology

Laboratory. Further, the EERC's multidisciplinary staff of more than 300 has maintained its leading role in coal research and has expanded its expertise and partnerships in a broad spectrum of energy and environmental programs. The EERC has successfully completed projects involving geological characterization of subsurface resources, experimental design, analytical methods development, groundwater quality, biomass-based energy, advanced power systems, atmospheric emission controls, reclamation of disturbed lands, disposal and value-added waste management, disposal site characterization, site remediation for oil and gas, cleanup of the federal weapons complex and industry sites, and training activities from a local to international scope.

The EERC's success has been supported by its long-standing partnership with the fossil fuel industry and DOE through the National Energy Technology Laboratory.

MANAGEMENT

Mr. Dan Stepan, EERC Senior Research Manager, will serve as Project Manager of the proposed project. He will have overall responsibility for the contract and will interface regularly with the NGPWC project partners and collaborators, project staff, and EERC senior management. He will be responsible for regular reporting to OGRC management and timely dissemination of information to other project partners. The other member of the EERC project management team will include Mr. John Harju, EERC Associate Director for Research.

TIMETABLE

The overall NGPWC Program period of performance is July 1, 2008, through December 31, 2009. The proposed period of performance for the Bakken Water Opportunities Assessment Project is shown in Figure 1 as well as major milestones and deliverables.

BUDGET

The total estimated cost for this project is \$230,000. Table 2 shows a summary of the funding for the proposed project.

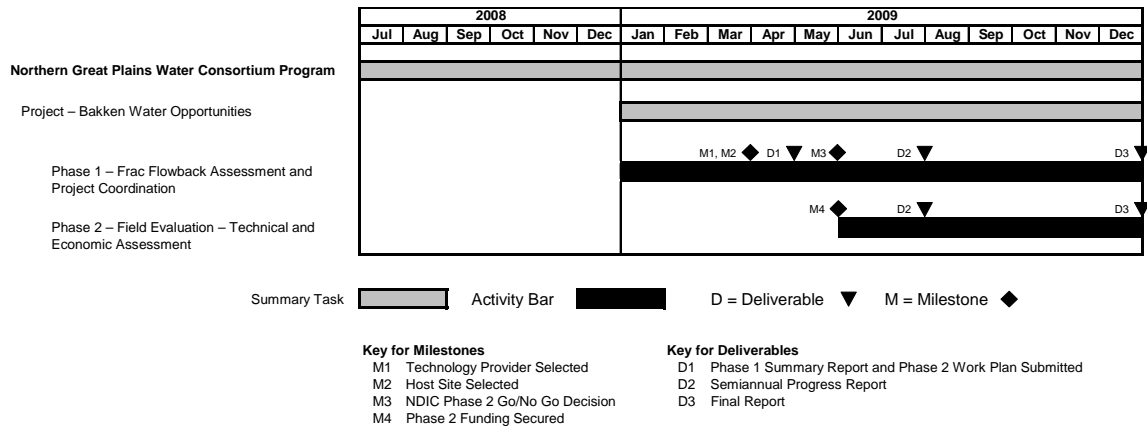


Figure 1. Project schedule, milestones, and deliverables.

Table 2. Funding Summary

	NDIC OGRC	NDPC	U.S. DOE	Other Matching Funds (TBD)	Total
Phase 1 – Frac Flowback Assessment and Project Coordination	\$ 25,000	\$ 10,000	\$ 25,000	\$ -	\$ 60,000
Phase 2 – Field Evaluation – Technical and Economic Assessment	\$ 85,000			\$ 85,000	\$ 170,000
Total	\$ 110,000	\$ 10,000	\$ 25,000	\$ 85,000	\$ 230,000

Phase 1 cost is estimated at \$60,000, of which this proposal requests \$25,000 from the NDIC OGRC, \$10,000 in cash will be provided by the North Dakota Petroleum Council (NDPC), and \$25,000 in cash will be provided by DOE under Cooperative Agreement DE-FC26-08NT43291. A detailed budget for Phase 1 is included in Appendix A. Phase 2 cost is estimated at \$170,000, of which this proposal requests \$85,000 from the NDIC OGRC. The balance of the funding for Phase 2 will be provided in the form of cash or cash equivalent by sponsors to be identified at a later time and may include the host site operator, NDPC members and its members, and/or DOE. A detailed budget for Phase 2 will be provided to the NDIC OGRC on April 30, 2009, with the attendant work plan (D1). Matching sponsors for Phase 2 will be identified at that time. The total requested from NDIC OGRC in this proposal is \$110,000, equivalent to 48% of the total project cost.

The total project budget is necessary to adequately address concerns surrounding the use of freshwater for hydraulic fracturing of oil wells in the Bakken formation. The level of OGRC funding is critical to demonstrate the common interest of the State of North Dakota and the state's oil and gas industry to optimize water usage in Bakken completions. Funding of a lesser amount is inadequate to demonstrate the potential for frac water recycling.

TAX LIABILITY

The EERC, a research organization within UND, which is an institution of higher education within the state of North Dakota, is not a taxable entity.

CONFIDENTIAL INFORMATION

No confidential information is included in this proposal. However, certain proprietary information relating to Bakken stimulation and completion may be provided to the EERC by participating companies. Confidential treatment of any such proprietary information may be necessary.

PATENTS AND RIGHTS TO TECHNICAL DATA

It is anticipated that no patents will be generated by the proposed activities. The rights to the technical data generated by this project will be held jointly by the EERC and the sponsoring partners.

APPENDIX A
BUDGET AND BUDGET NOTES

PHASE I BUDGET

CATEGORY	HOURLY		TOTAL		NDIC SHARE		OTHER SHARE		DOE SHARE	
	Rate	Hrs	Cost	Hrs	Cost	Hrs	Cost	Hrs	Cost	
LABOR										
Stepan, D. Project Manager	\$ 55.05	90	\$ 4,955	32	\$ 1,762	30	\$ 1,652	28	\$ 1,541	
Ziman, J. Principal Investigator	\$ 25.96	172	\$ 4,465	32	\$ 831	20	\$ 519	120	\$ 3,115	
Harju, J. Principal Investigator	\$ 82.73	36	\$ 2,978	20	\$ 1,655	10	\$ 827	6	\$ 496	
----- Senior Management	\$ 65.65	17	\$ 1,116	-	\$ -	-	\$ -	17	\$ 1,116	
----- Research Scientist/Engineer	\$ 36.27	22	\$ 798	22	\$ 798	-	\$ -	-	\$ -	
----- Research Technician	\$ 23.45	22	\$ 516	-	\$ -	-	\$ -	22	\$ 516	
----- Technical Support Services	\$ 19.31	12	\$ 232	12	\$ 232	-	\$ -	-	\$ -	
			\$ 15,060		\$ 5,278		\$ 2,998		\$ 6,784	
Escalation Above Base	3%		\$ 452		\$ 158		\$ 90		\$ 204	
TOTAL DIRECT HRS/SALARIES			371	\$ 15,512	118	\$ 5,436	60	\$ 3,088	193	\$ 6,988
Fringe Benefits - % of Direct Labor - Staff	53.3%		\$ 8,268		\$ 2,897		\$ 1,646		\$ 3,725	
TOTAL FRINGE BENEFITS			\$ 8,268		\$ 2,897		\$ 1,646		\$ 3,725	
TOTAL LABOR			\$ 23,780		\$ 8,333		\$ 4,734		\$ 10,713	
TRAVEL			\$ 6,809		\$ 2,000		\$ -		\$ 4,809	
SUPPLIES			\$ 2,535		\$ -		\$ 1,466		\$ 1,069	
COMMUNICATION - PHONES & POSTAGE			\$ 100		\$ -		\$ 25		\$ 75	
PRINTING & DUPLICATING			\$ 100		\$ 75		\$ 25		\$ -	
FOOD			\$ 200		\$ 200		\$ -		\$ -	
OPERATING FEES & SVCS										
Outside Lab.			\$ 5,017		\$ 5,017		\$ -		\$ -	
TOTAL DIRECT COST			\$ 38,541		\$ 15,625		\$ 6,250		\$ 16,666	
FACILITIES & ADMIN. RATE - % OF MTDC		VAR	\$ 21,459		60% \$ 9,375		60% \$ 3,750		50% \$ 8,334	
TOTAL PROJECT COST			\$ 60,000		\$ 25,000		\$ 10,000		\$ 25,000	

Due to limitations within the University's accounting system, bolded budget line items represent how the University proposes, reports and accounts for expenses. Supplementary budget information, if provided, is for proposal evaluation.

BAKKEN WATER OPPORTUNITIES ASSESSMENT
 EERC PROPOSAL #2009-0107

DETAILED BUDGET - TRAVEL

RATES USED TO CALCULATE ESTIMATED TRAVEL EXPENSES						
DESTINATION	AIRFARE	PER MILE	LODGING	PER DIEM	CAR RENTAL	
Williston, ND	\$ -	\$ 0.33	\$ 65	\$ 25	\$ -	
Dallas, TX	\$ 750	\$ -	\$ 250	\$ 59	\$ 85	

PURPOSE/DESTINATION	NUMBER OF				AIRFARE	MILEAGE	LODGING	PER DIEM	CAR RENTAL	MISC.	TOTAL
	TRIPS	PEOPLE	MILES	DAYS							
Site Visit/Williston, ND (1 person)	3	1	870	6	\$ -	\$ 861	\$ 975	\$ 450	\$ -	\$ 180	\$ 2,466
Site Visit/Williston, ND (2 people)	2	2	870	2	\$ -	\$ 574	\$ 260	\$ 200	\$ -	\$ 80	\$ 1,114
Site Visit/Dallas, TX	1	2	-	3	\$ 1,500	\$ -	\$ 1,000	\$ 354	\$ 255	\$ 120	\$ 3,229
TOTAL ESTIMATED TRAVEL PHASE I											<u>\$ 6,809</u>

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 receives no appropriated funding from the state of North Dakota and 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

If federal funding is proposed as part of this project, the applicable federal intellectual property (IP) regulations may govern any resulting research agreement. In addition, in the event that IP with the potential to generate revenue to which the EERC is entitled is developed under this agreement, 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.) is for planning purposes only. The project manager may, as dictated by the needs of the work, incur costs in accordance with Office of Management and Budget (OMB) Circular A-21 found at www.whitehouse.gov/omb/circulars. If the Scope of Work (by task, if applicable) encompasses research activities which may be funded by one or more sponsors, then allowable project costs may be allocated at the Scope of Work or task level, as appropriate, to any or all of the funding sources. Financial reporting will be at the total-agreement level.

Escalation of labor and EERC recharge center rates is incorporated into the budget when a project's duration extends beyond the current fiscal year. 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: The EERC employs administrative staff to provide required services for various direct and indirect support functions. 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 current average rate of a personnel group with a similar job description. Salary costs incurred are based on direct hourly effort on the project. Faculty who work on this project will be paid an amount over their normal base salary, creating an overload which is subject to limitation in accordance with university policy. Costs for general support services such as contracts and intellectual property, accounting, human resources, purchasing, shipping/receiving, and clerical support of these functions are included in the EERC facilities and administrative cost rate.

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, and covers vacation, holiday, and sick leave (VSL). This percentage is applied to direct labor for permanent staff eligible for VSL benefits. 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 is estimated on the basis of UND travel policies which can be found at www.und.edu/dept/accounts/policiesandprocedures.html. Estimates include General Services Administration (GSA) daily meal rates. Travel may include site visits, field work, meetings, and conference participation as indicated by the scope of work and/or budget.

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

Supplies – Professional, Information Technology, and Miscellaneous: Supply and material estimates are based on prior experience and may include chemicals, gases, glassware, nuts, bolts, and piping. Computer supplies may include data storage, paper, memory, software, and toner cartridges. Maps, sample containers, minor equipment, signage, and safety supplies may be necessary as well as other organizational materials such as subscriptions, books, and reference materials. General purpose office supplies (pencils, pens, paper clips, staples, Post-it notes, etc.) are included in the facilities and administrative cost.

Subcontracts/Subrecipients: Not applicable.

Professional Fees/Services (consultants): Not applicable.

Other Direct Costs

Communications and Postage: Telephone, cell phone, and fax line charges are generally included in the facilities and administrative cost. Direct project costs may include line charges at remote locations, long-distance telephone, postage, and other data or document transportation costs.

Printing and Duplicating: Photocopy estimates are based on prior experience with similar projects. Page rates for various photocopiers are established annually by the university's duplicating center.

Food: Food expenditures for project meetings, workshops, and conferences where the primary purpose is dissemination of technical information may include costs of food, some of which may exceed the institutional limit.

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 development and execution of the project by the research team.

Fees and Services – EERC Recharge Centers, Outside Labs, Freight: EERC recharge center rates for laboratory, analytical, graphics, and shop/operation fees are anticipated to be approved for use beginning July 1, 2008. Only the actual approved rates will be charged to the project.

Laboratory and analytical fees are charged on a per sample, hourly, or daily rate, depending on the analytical services performed. Additionally, laboratory analyses may be performed outside the university when necessary.

Graphics fees are based on an established per hour rate for production of such items as report figures, posters, and/or PowerPoint images for presentations, maps, schematics, Web site design, professional brochures, and photographs.

Shop and operation fees are for expenses directly associated with the operation of the pilot plant facility. These fees cover such items as training, personal safety (protective eyeglasses, boots, gloves), and physicals for pilot plant and shop personnel.

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

Facilities and Administrative Cost: Facilities and administrative cost is calculated on modified total direct costs (MTDC). MTDC is defined as total direct costs less individual items of equipment in excess of \$5000 and subawards in excess of the first \$25,000 for each award. The EERC Facilities and Administrative rate for commercial entities as proposed in this budget is 60%. The components are as follows: the approved federal rate is 50%; added to the federal rate is an increment of 10%. This increment represents calculated costs that exceed the allowable 26% federal cap on Administrative costs as well as depreciation/use allowance on buildings and equipment purchased with federal dollars.