Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

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World Wide Web Server Address: www.eerc.und.nodak.edu

July 2, 1999

Ms. Karlene Fine
Executive Director
Industrial Commission of North Dakota
600 East Boulevard
State Capitol, 10th Floor
Bismarck, ND 58505-0310

Dear Ms. Fine:

Subject: EERC Proposal No. 99-0102-R1, "Powdered Activated Carbon from North Dakota Lignite: An Option for Disinfection By-Product Control in Water Treatment Plants"

This letter is to notify you of a revised request for funding from the Industrial Commission of North Dakota (ICND) for the subject Energy & Environmental Research Center (EERC) proposal. The scope of work remains the same, and the $60,000 in-kind contribution from the city of Grand Forks remains as cost share. We are requesting $30,000 from ICND, with the industrial match from membership fees to the Red River Water Management Consortium (RRWMC) from American Crystal Sugar Company, J.R. Simplot Company, and Northern States Power Company. The use of RRWMC funds as a match has been approved by Mr. Tom Moe, RRWMC Program Coordinator, and Mr. Ed Steadman, EERC Associate Director for Research. The project will also be added as a Special Topics task to the RRWMC work plan. I have enclosed a revised budget to reflect these changes.

If you have any questions, please feel free to contact me at your convenience by phone at (701) 777-5247, by fax at (701) 777-5181, or by e-mail at dstepan@eerc.und.nodak.edu.

Sincerely,

Daniel J. Stepan
Research Manager

Approved by:

Dr. Carl A. Fox, Director
Office of Research and Program Development

DJS/drh

Enclosure

c: Clifford Porter, Lignite Energy Council
John Hendrikson, EERC

SUMMARY BUDGET

POWDERED ACTIVATED CARBON FROM NORTH DAKOTA LIGNITE
NDIC/DOE
PROPOSED START DATE: 08/01/99
EERC PROPOSAL #99-0102-R1 02-Jul-99

PROJECT TOTAL

	TOTAL		NDIC SHARE		OTHER COMM. SHARE		EERC JSRP SHARE	
	HOURS	$ COST	HOURS	$ COST	HOURS	$ COST	HOURS	$ COST
TOTAL DIRECT LABOR	2437	$45,314	448	$11,675	947	$14,708	1042	$18,931
FRINGE BENEFITS - % OF DIRECT LABOR		$15,777		$5,429		$4,322		$6,026
TOTAL LABOR		$61,091		$17,104		$19,030		$24,957
OTHER DIRECT COSTS								
SUPPLIES		$2,000		$753		$297		$950
COMMUNICATIONS - PHONES & POSTAGE		$534		$258		$113		$163
OFFICE (PROJECT SPECIFIC SUPPLIES)		$500		$220		$40		$240
GENERAL (FREIGHT, FOOD, MEMBERSHIPS, ETC.)		$850		$455		$0		$395
FEES		$1,383		$691		$0		$692
TOTAL OTHER DIRECT COST		$5,267		$2,377		$450		$2,440
TOTAL DIRECT COST		$66,358		$19,481		$19,480		$27,397
INDIRECT COST - % OF MTDC	VAR	$33,642	54%	$10,519	54%	$10,520	46%	$12,603
TOTAL EERC ESTIMATED COST		$100,000		$30,000		$30,000		$40,000
CITY OF GRAND FORKS - IN-KIND COST SHARE		$60,000		$0		$60,000		$0
TOTAL PROJECT COST		$160,000		$30,000		$90,000		$40,000

NOTE: Due to limitations within the university's accounting system, the system does not provide for accumulating and reporting expenses at the Detailed Budget level. The Summary Budget is presented for the purpose of how we propose, account, and report expenses. The Detailed Budget is presented to assist in the evaluation of the proposal.

DETAILED BUDGET

POWDERED ACTIVATED CARBON FROM NORTH DAKOTA LIGNITE
NDIC/DOE
PROPOSED START DATE 08/01/99
EERC PROPOSAL #99-0102-R1

02-Jul-99

YEAR 1

LABOR	LABOR CATEGORY	HOURLY RATE	YEAR 1 HOURS	YEAR 1 $ COST	NDIC SHARE HOURS	NDIC SHARE $ COST	OTHER COMM. SHARE HOURS	OTHER COMM. SHARE $ COST	EERC/JSRP SHARE HOURS	EERC/JSRP SHARE $ COST
D. STEPAN	PROJECT MANAGER	$26.51	340	$9,013	180	$4,772	32	$848	128	$3,393
C. MORETTI	FACULTY	$31.68	85	$2,693	25	$792	0	$0	60	$1,901
T. MOE	RES. SCIENTIST II	$23.10	160	$3,696	0	$0	128	$2,957	32	$739
E. OLSON	PRINCIPAL SCIENTIST	$35.45	44	$1,560	22	$780	0	$0	22	$780
---------------	SENIOR MANAGEMENT	$41.16	32	$1,317	10	$412	10	$411	12	$494
---------------	QUALITY CONTROL MANAGE	$21.85	7	$153	2	$44	2	$43	3	$66
---------------	RESEARCH TECHNICIAN	$14.78	60	$887	15	$222	15	$222	30	$443
---------------	GRADUATES-RES.	$10.00	882	$8,820	0	$0	500	$5,000	382	$3,820
---------------	TECHNICAL SUPPORT SERVIC	$11.18	34	$380	16	$179	0	$0	18	$201
			1644	$28,519	270	$7,201	687	$9,481	687	$11,837
ESCALATION ABOVE CURRENT BASE			5%	$1,426		$360		$474		$592
TOTAL DIRECT LABOR				$29,945		$7,561		$9,955		$12,429
FRINGE BENEFITS - % OF DIRECT LABOR		52%		$9,285		$3,499		$2,447		$3,339
FRINGE BENEFITS - % OF FACULTY		25%		$707		$208		$0		$499
FRINGE BENEFITS - % OF GRADUATES-RES.		3%		$278		$0		$158		$120
TOTAL FRINGE BENEFITS				$10,270		$3,707		$2,605		$3,958
TOTAL LABOR				$40,215		$11,268		$12,560		$16,387
OTHER DIRECT COSTS										
SUPPLIES				$1,500		$603		$297		$600
COMMUNICATIONS - PHONES & POSTAGE				$424		$230		$100		$94
OFFICE (PROJECT SPECIFIC SUPPLIES)				$350		$180		$30		$140
GENERAL (FREIGHT, FOOD. MEMBERSHIPS, ETC.)				$600		$360		$0		$240
GRAPHICS				$693		$346		$0		$347
TOTAL OTHER DIRECT COST				$3,567		$1,719		$427		$1,421
TOTAL DIRECT COST				$43,782		$12,987		$12,987		$17,808
INDIRECT COST - % OF MTDC			VAR	$22,218	54%	$7,013	54%	$7,013	46%	$8,192
TOTAL EERC ESTIMATED COST				$66,000		$20,000		$20,000		$26,000
CITY OF GRAND FORKS - IN-KIND COST SHARE				$40,000		$0		$40,000		$0
TOTAL PROJECT COST				$106,000		$20,000		$60,000		$26,000

YEAR 2

LABOR	LABOR CATEGORY	YEAR 2 HOURS	YEAR 2 $ COST	NDIC SHARE HOURS	NDIC SHARE $ COST	OTHER COMM. SHARE HOURS	OTHER COMM. SHARE $ COST	EERC/JSRP SHARE HOURS	EERC/JSRP SHARE $ COST
D. STEPAN	PROJECT MANAGER	192	$5,090	95	$2,518	40	$1,061	57	$1,511
C. MORETTI	FACULTY	35	$1,109	10	$317	0	$0	25	$792
T. MOE	RES. SCIENTIST II	108	$2,495	0	$0	68	$1,571	40	$924
E. OLSON	PRINCIPAL SCIENTIST	0	$0	0	$0	0	$0	0	$0
---------------	SENIOR MANAGEMENT	16	$659	4	$165	4	$165	8	$329
---------------	QUALITY CONTROL MANAGE	4	$87	1	$22	1	$21	2	$44
---------------	RESEARCH TECHNICIAN	30	$443	8	$118	7	$103	15	$222
---------------	GRADUATES-RES.	400	$4,000	60	$600	140	$1,400	200	$2,000
---------------	TECHNICAL SUPPORT SERVIC	8	$89	0	$0	0	$0	8	$89
		793	$13,972	178	$3,740	260	$4,321	355	$5,911
ESCALATION ABOVE CURRENT BASE		10%	$1,397		$374		$432		$591
TOTAL DIRECT LABOR			$15,369		$4,114		$4,753		$6,502
FRINGE BENEFITS - % OF DIRECT LABOR			$5,070		$1,615		$1,671		$1,784
FRINGE BENEFITS - % OF FACULTY			$305		$87		$0		$218
FRINGE BENEFITS - % OF GRADUATES-RES.			$132		$20		$46		$66
TOTAL FRINGE BENEFITS			$5,507		$1,722		$1,717		$2,068
TOTAL LABOR			$20,876		$5,836		$6,470		$8,570
OTHER DIRECT COSTS									
SUPPLIES			$500		$150		$0		$350
COMMUNICATIONS - PHONES & POSTAGE			$110		$28		$13		$69
OFFICE (PROJECT SPECIFIC SUPPLIES)			$150		$40		$10		$100
GENERAL (FREIGHT, FOOD. MEMBERSHIPS, ETC.)			$250		$95		$0		$155
GRAPHICS			$690		$345		$0		$345
TOTAL OTHER DIRECT COST			$1,700		$658		$23		$1,019
TOTAL DIRECT COST			$22,576		$6,494		$6,493		$9,589
INDIRECT COST - % OF MTDC		VAR	$11,424	54%	$3,506	54%	$3,507	46%	$4,411
TOTAL EERC ESTIMATED COST			$34,000		$10,000		$10,000		$14,000
CITY OF GRAND FORKS - IN-KIND COST SHARE			$20,000		$0		$20,000		$0
TOTAL PROJECT COST			$54,000		$10,000		$30,000		$14,000

PROJECT TOTAL

LABOR	LABOR CATEGORY	PROJECT TOTAL HOURS	PROJECT TOTAL $ COST	NDIC SHARE HOURS	NDIC SHARE $ COST	OTHER COMM. SHARE HOURS	OTHER COMM. SHARE $ COST	EERC JSRP SHARE HOURS	EERC JSRP SHARE $ COST
D. STEPAN	PROJECT MANAGER	532	$14,103	275	$7,290	72	$1,909	185	$4,904
C. MORETTI	FACULTY	120	$3,802	35	$1,109	0	$0	85	$2,693
T. MOE	RES. SCIENTIST II	268	$6,191	0	$0	196	$4,528	72	$1,663
E. OLSON	PRINCIPAL SCIENTIST	44	$1,560	22	$780	0	$0	22	$780
---------------	SENIOR MANAGEMENT	48	$1,976	14	$577	14	$576	20	$823
---------------	QUALITY CONTROL MANAGE	11	$240	3	$66	3	$64	5	$110
---------------	RESEARCH TECHNICIAN	90	$1,330	23	$340	22	$325	45	$665
---------------	GRADUATES-RES.	1282	$12,820	60	$600	640	$6,400	582	$5,820
---------------	TECHNICAL SUPPORT SERVIC	42	$469	16	$179	0	$0	26	$290
		2437	$42,491	448	$10,941	947	$13,802	1042	$17,748
ESCALATION ABOVE CURRENT BASE			$2,823		$734		$906		$1,183
TOTAL DIRECT LABOR			$45,314		$11,675		$14,708		$18,931
FRINGE BENEFITS - % OF DIRECT LABOR			$14,355		$5,114		$4,118		$5,123
FRINGE BENEFITS - % OF FACULTY			$1,012		$295		$0		$717
FRINGE BENEFITS - % OF GRADUATES-RES.			$410		$20		$204		$186
TOTAL FRINGE BENEFITS			$15,777		$5,429		$4,322		$6,026
TOTAL LABOR			$61,091		$17,104		$19,030		$24,957
OTHER DIRECT COSTS									
SUPPLIES			$2,000		$753		$297		$950
COMMUNICATIONS - PHONES & POSTAGE			$534		$258		$113		$163
OFFICE (PROJECT SPECIFIC SUPPLIES)			$500		$220		$40		$240
GENERAL (FREIGHT, FOOD. MEMBERSHIPS, ETC.)			$850		$455		$0		$395
GRAPHICS			$1,383		$691		$0		$692
TOTAL OTHER DIRECT COST			$5,267		$2,377		$450		$2,440
TOTAL DIRECT COST			$66,358		$19,481		$19,480		$27,397
INDIRECT COST - % OF MTDC		VAR	$33,642	54%	$10,519	54%	$10,520	46%	$12,603
TOTAL EERC ESTIMATED COST			$100,000		$30,000		$30,000		$40,000
CITY OF GRAND FORKS - IN-KIND COST SHARE			$60,000		$0		$60,000		$0
TOTAL PROJECT COST			$160,000		$30,000		$90,000		$40,000

DETAILED BUDGET - FEES

POWDERED ACTIVATED CARBON FROM NORTH DAKOTA LIGNITE
EERC PROPOSAL #99-0102-R1

		YEAR 1		YEAR 2		TOTAL	
GRAPHICS SUPPORT COST CENTER	**RATE**	**#**	**$ COST**	**#**	**$ COST**	**#**	**$ COST**
GRAPHICS(HOURLY)	$33	20	$660	19	$627	39	$1,287
			----------------		----------------		----------------
SUBTOTAL			$660		$627		$1,287
ESCALATION	5%		$33	10%	$63		$96
			----------------		----------------		----------------
TOTAL GRAPHICS SUPPORT COST CENTER			$693		$690		$1,383
			=========		=========		=========

BUDGET NOTES

ENERGY & ENVIRONMENTAL RESEARCH CENTER (EERC)

Background

The EERC is an independently organized multidisciplinary research center within the University of North Dakota. The EERC receives no appropriated funding from the state of North Dakota and is funded through federal and nonfederal grants, contracts, or other agreements. Although the EERC is not affiliated with any one academic department, university academic faculty may participate in a project based on the scope of work and expertise required to perform the project.

The proposed work will be done on a cost-reimbursable basis. The distribution of costs between budget categories (labor, travel, supplies, equipment, subcontracts) is for planning purposes only. The principal investigator may, as dictated by the needs of the work, reallocate the budget among approved items or use the funds for other items directly related to the project, subject only to staying within the total dollars authorized for the overall program. The budget for this proposal has been prepared based on a specific start date; this start date is indicated at the top of the EERC detail budget or identified in the body of the proposal. Please be aware that any delay in the start of this project may result in an increase in the budget. Financial reporting will be at the total project level.

Salaries and Fringe Benefits

As an interdisciplinary, multiprogram, and multiproject research center, the EERC employs an administrative staff to provide required services for various direct and indirect support functions. Direct project salaries are estimated based on the scope of work and prior experience on projects of similar scope. Technical and administrative salaries are charged based on direct hourly effort on the project. For faculty, if the effort occurs during the academic year and crosses departmental lines, the salary will be in addition to the normal base salary. University policy allows faculty, who perform work in addition to their academic contract, to receive no more than 20% over the base salary. Costs for general support services, such as grants and contracts administration, accounting, personnel, purchasing and receiving, as well as clerical support of these functions, are included in the indirect cost of the EERC.

Fringe benefits are estimated based on historical data. The fringe benefits actually charged consist of two components. The first component covers average vacation, holiday, and sick leave (VSL) for the EERC. This component is approved by the UND cognizant audit agency and charged as a percentage of direct labor on permanent staff employees eligible for VSL benefits. The second component covers actual expenses for items such as health, life, and unemployment insurance; social security matching; worker's compensation; and UND retirement contributions.

Travel

Travel is estimated based on UND travel policies, which include estimated GSA daily meal rates. Travel includes scheduled meetings and conference participation as indicated in the scope of work.

Communications (Phones and Postage)

Monthly telephone services and fax telephone lines are included in indirect cost. Direct project cost includes long-distance telephone including fax-related long-distance calls; postage for regular, air, and express mail; and other data or document transportation costs.

Office (Project Specific Supplies)

General purpose office supplies (pencils, pens, paper clips, staples, Post-it notes, etc.) are provided through a central storeroom at no cost to individual projects. Budgeted project office supplies include items specifically related to the project: special research notebooks, binders, and other project organizational materials; duplicating, printing, special covers or paper, and binding of reports; project data forms, transparencies or other presentation materials; literature searches and technical information procurement, including subscriptions; manuals, computer diskettes, memory chips, laser printer paper, and toner cartridges; and other miscellaneous supplies required to complete the project.

Data Processing

Data processing includes items such as site licenses and computer software.

Supplies

Supplies in this category include scientific supply items such as chemicals, gases, and glassware and/or other project items such as: nuts, bolts, and piping necessary for pilot plant operations.

Fees

Laboratory and analytical fees are established and approved at the beginning of each fiscal year and are charged based on a per sample or hourly charge depending on the analytical services performed. Additionally, laboratory analyses may be performed outside the University when necessary.

Engineering support fees are based on an established per hour rate for drafting services related to the production of drawings as part of EERC's quality assurance/quality control program for complying with piping and pressure vessel codes.

Graphic services fees are based on an established per hour rate for overall graphics production such as report figures, poster sessions, standard word or table slides, simple maps, schematic slides, desktop publishing, photographs, and printing or copying.

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

General

Membership fees (if included) 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 as well as by the research team directly involved in project activity.

General expenditures for project meetings, workshops and conferences may include such items as food (some of which may exceed the institutional established limits), room amenities (e.g., place cards, music, banners, floral arrangements), speaker and participant gifts, security, interpreters, technical tour transportation, and room and equipment rental necessary to conduct project meetings, workshops and conferences.

Indirect Cost

The indirect cost rate included in this proposal is the rate which became effective July 1, 1995. Indirect cost is calculated on modified total direct costs (MTDC). MTDC is defined as total direct costs less individual items of equipment in excess of $750 and subcontracts/subgrants in excess of the first $25,000 of each award.

Exhibit A

Energy & Environmental Research Center

POWDERED ACTIVATED CARBON FROM NORTH DAKOTA LIGNITE: AN OPTION FOR DISINFECTION BY-PRODUCT CONTROL IN WATER TREATMENT PLANTS

EERC Proposal No. 99-0102

Submitted to:

Ms. Karlene Fine
Executive Director
Industrial Commission of North Dakota
600 East Boulevard
State Capitol, 10th Floor
Bismarck, ND 58505-0310

Submitted by:

Daniel J. Stepan
Thomas A. Moe
Charles J. Moretti
Edwin S. Olson

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, ND 58202-9018

Daniel J. Stepan, Project Manager

Dr. Carl A. Fox, Director
Office of Research and Program Development

Amount Requested: $60,000

April 30, 1999

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POWDERED ACTIVATED CARBON FROM NORTH DAKOTA LIGNITE: AN OPTION FOR DISINFECTION BY-PRODUCT CONTROL IN WATER TREATMENT PLANTS

ABSTRACT

New federal regulations developed to address the production of disinfection by-products such as trihalomethanes (THMs) and haloacetic acids formed during the chlorination of drinking water mandate additional treatment. Many options have been evaluated, including membrane processes, granular activated carbon, powdered activated carbon (PAC), enhanced coagulation, and alternative disinfection processes such as ozonation and chloramination. Of all the processes studied to date, PAC appears to offer the best benefit-to-cost advantage for most water treatment plants.

The Grand Forks Water Treatment Plant, the University of North Dakota Department of Civil Engineering, and the Energy & Environmental Research Center (EERC) propose to evaluate a North Dakota lignite-derived PAC for removal of naturally occurring organic matter from water and reduction of THM formation potential. The objective is to develop a statistically valid testing protocol that can be used to determine a dose–response relationship for five different PACs tested on waters from five different water treatment plants. The resulting dose–response curves will characterize the effects of PAC dose, water temperature, and contact time. Pertinent physical and chemical properties will be measured for each of the waters and each of the PACs. Statistical analysis will determine whether significant correlations exist between water properties, PAC properties, and dose–response behavior. PAC-handling characteristics will also be studied.

The project will be conducted over a period of 18 months for a cost of $60,000.

POWDERED ACTIVATED CARBON FROM NORTH DAKOTA LIGNITE: AN OPTION FOR DISINFECTION BY-PRODUCT CONTROL IN WATER TREATMENT PLANTS

1.0 PROJECT SUMMARY

New federal regulations developed to address the production of disinfection by-products such as trihalomethanes (THM) and haloacetic acids (HAA) formed during the chlorination of drinking water mandate additional treatment. Many options have been evaluated, including membrane processes, granular activated carbon, powdered activated carbon (PAC), enhanced coagulation, and alternative disinfection processes such as ozonation and chloramination. Of all processes studied to date, PAC appears to offer the best benefit-to-cost advantage for most water treatment plants.

PAC has traditionally been used in water treatment for the removal of compounds contributing to taste and odor problems. PAC also has the potential to remove naturally occurring organic matter (NOM) from raw waters prior to disinfection, thus controlling the formation of THMs and HAAs. The major advantage of using PAC for the removal of NOM is that it requires a relatively small cost expenditure to set up a PAC system compared to the other process alternatives. Over 4600 small water systems (those serving less than 100,000 people) are currently using PAC for taste and odor control and have the potential to use PAC for controlling disinfection by-products.

The project proposed by the Grand Forks Water Treatment Plant, the University of North Dakota (UND) Department of Civil Engineering, and the Energy & Environmental Research Center (EERC) consists of several interrelated tasks. The objective of the research is to evaluate a cost-effective PAC produced from North Dakota lignite for removing NOM from water and reducing THM formation potential. The research approach is to develop a statistically valid testing protocol that can be used to compare dose–response relationships between North Dakota lignite-derived PAC and commercially available PAC products. A statistical analysis will be performed to determine whether significant correlations exist between operating conditions, water properties, PAC properties, and dose–response behavior. Pertinent physical and chemical properties will also be measured for each of the waters and each of the PACs.

2.0 PROJECT DESCRIPTION

2.1 Task 1 – Preparation of PAC from North Dakota Lignite

A recently proposed project to develop a PAC from a North Dakota lignite has been approved for funding by the U.S. Department of Energy (DOE). The purpose of that project is to develop a methodology for production of a cost-effective sorbent for the removal of NOM from surface water supplies. The project will involve testing to define optimal carbonization and steam activation conditions and will include the preparation of several carbons prepared from Beulah–Zap lignite. We hypothesize that the effects of mineral content on the sorption activity of the carbon will be significant because of its effect on carbon burnoff and porosity as well as the binding of the carbon to ionic material in the water. Both a high-sodium (8%–9% mf ash) and a high-calcium lignite (12% mf ash) will be tested. A demineralized coal will also be used in the initial phase. The initial carbonization temperature for the three coals will be 400°C. Carbonization temperatures may be increased according to need. The resulting chars will be activated with steam at two temperatures using two reaction times. These parameters will also determine the surface area and porosity and, therefore, the sorption effectiveness of the carbons. Thus the preparation matrix will produce 12 activated carbons for evaluation. Subsequent work in the DOE project will investigate other activation gas compositions: air, nitrogen, CO_2, H_2 (increased hydrophobicity), and effects of heating rates. Only small quantities of PAC will be produced during that investigation. Limited sorption testing will also be conducted. Knife River Coal Mining Company has agreed to provide samples of both high-sodium and high-calcium lignites for the investigation.

The proposed Task 1 effort under this project will involve more detailed sorption testing of the lignite-derived PAC for removing NOM from raw water supplies. Based on the results of the testing, the best-performing PAC will be produced in larger quantities which will be required for the rest of the testing program.

2.2 Task 2 – Collection and Characterization of Waters and PACs

Various waters will be obtained from five treatment plants with histories of treating raw waters with high levels of NOM and relatively high THM formation potentials. The Grand Forks Water Treatment Plant will be one of the five. The other four plants will be selected to represent a wide range of geographical locations. The American Water Works Association (AWWA) Small Systems Program will be consulted about the selection of plants. A minimum of 100 liters of water will be obtained from each source. All water will be refrigerated upon receipt and kept at a temperature between 1° and 3°C until used. Each water sample will be characterized for parameters that may influence PAC performance, including total organic carbon (TOC), dissolved organic carbon (DOC), THM formation potential, turbidity, conductivity, alkalinity, hardness, and pH. Test methods for the source water characterization analyses are listed in Table 1.

In addition to the North Dakota lignite-derived PAC, four other PACs will be selected based on their reported ability to work well for removal of organics from water. Based on previous research, it is expected that at least two of the other selected PACs will be coal- or lignite-derived material. The North Dakota lignite-derived PAC will be characterized for moisture, ash, density, pH, water solubles, sieve −200, sieve −325, molasses number, iodine number, surface area, phenol

Table 1. Source Water Characterization Test Methods[1]

Parameter	Test Method
TOC	5310C
DOC	5310C after filtering
THM Formation Potential[2]	5710B, 6230E
Alkalinity	2320B
Hardness	2340C
Conductivity	2510B
pH	4500
Turbidity	2130B
THM	6210D

[1] All test methods are from American Public Health Association (APHA) (1992), with the exception of THM formation potential.
[2] Test method taken from APHA (1995).

number, and tannin value. These indices will be compared to those of the commercial PACs. Test methods for the characterization of the PAC are listed in Table 2.

2.3 Task 3 – Adsorption Tests for Water–PAC Combinations

Each water will be subjected to a statistically valid testing protocol designed to relate removal of NOM and reduction of THM formation potential to PAC dose, contact time, and water temperature. NOM reduction will be determined by the TOC concentrations of the water before and after the adsorption test. A full factorial design for three variables will be used for the test matrix. This approach requires testing three preset levels for each independent variable. The values used for the independent variables are shown in Table 3. The test matrix contains nine different sets of conditions, with a replication of center-point conditions (see Table 4). The low value for the variable is indicated with a – 1, the center point value is indicated with a 0, and the high value is indicated with a +1 in the matrix.

Table 2. Test Methods for Characterization of PACs

Parameter	Method
Moisture	AWWA B600-90
Ash	ASTM[1] D2866
Density	AWWA B600-90
pH	ASTM D3838
Water Solubles	ASTM 5029
Sieve -200	AWWA B600-90
Sieve -325	AWWA B600-90
Molasses Number	Hassler, 1967
Iodine Number	ASTM D4607
Surface Area	ASTM D3037
Phenol Number	AWWA B600-78
Tannin Value	AWWA B600-78

[1] American Society for Testing and Materials.

Table 3. Low, Intermediate, and High Values of Independent Variables Used for Each Adsorption Test

Variable	Low Value	Intermediate Value	High Value
PAC Concentration	5 mg/L	52.5 mg/L	100 mg/L
Contact Time	20 minutes	70 minutes	120 minutes
Water Temperature	5°C	15°C	25°C

Each line of the test matrix will be evaluated with a single, jar-type adsorption test. Fifty adsorption tests will be done for each source water, ten tests with each of the five selected PACs. Thus the entire test program will require 250 individual adsorption tests.

2.4 Task 4 – Statistical Analysis of the Adsorption Test Data

The data collected from the adsorption tests will be analyzed with a SAS™ statistical analysis software package. The relative effect of each independent variable on TOC and THM formation potential reductions will be determined as well as the effects of any interactions

Table 4. 2^3 Factorial Test Matrix (to be used for each source water and PAC type)

Test Number	PAC Concentration	Contact Time	Water Temperature
1	-1	-1	-1
2	+1	-1	-1
3	+1	+1	-1
4	+1	+1	+1
5	0	0	0
6	+1	-1	+1
7	-1	-1	+1
8	-1	+1	+1
9	-1	+1	-1
10	0	0	0

between the independent variables. These effects will be used to develop a mathematical equation relating the response variables and the operating conditions for each test matrix. Thus two equations, one for TOC removal and one for THM formation potential reduction, will be determined for each matrix. Each of these equations will be plotted in a three-dimensional coordinate system with water temperature and contact time as independent variables and response as the dependent variable. One plot will be made for each PAC dose tested.

For each water–PAC combination, the water temperature, PAC dose, and contact time (CT) that results in the greatest reduction in TOC and THM formation potential will be predicted using the mathematical equations. After all of the water–PAC matrices have been completed, the results will be compared. Conclusions will be drawn about conditions under which each PAC is most effective and which PAC is the most effective for each water type. Using the mathematical equations, a series of plots of TOC removal (or THM formation potential reduction) as a function of water temperature at the most effective PAC dose and CT will be made for each water type. Plants treating waters similar to those characterized for this study can use these curves to select PACs, estimate PAC dose and contact time, and evaluate the effect of water temperature for their own waters. Minimal additional adsorption testing may be needed to verify the estimated "best" treatment conditions prior to full-scale use.

2.5 Task 5 – Reporting

Project status reports will be prepared quarterly throughout the duration of the project. In addition, more technically detailed project status reports will be prepared semiannually. These reports will be submitted to the North Dakota Industrial Commission (NDIC), DOE, and the Knife River Coal Company. A draft final project report will be prepared upon completion of all testing and evaluation, and a final report will be completed following review by project sponsors..

3.0 STANDARDS OF SUCCESS

The standards of success for this project will be the relative removal of NOM from the test waters, as evidenced by TOC removal, and the reduction of THM formation potential. This will give a direct indication of the potential for limiting THM formation and an economically viable treatment alternative for meeting the expected more stringent federal regulations placed on finished drinking water quality. Treated water values of <4.0 ppm TOC and ≤ 0.08 ppm THM formation potential will be considered as successful treatment.

To ensure the quality of experimental data, quality assurance/quality control (QA/QC) procedures will be used. The QA/QC plan is presented in Appendix A.

4.0 BACKGROUND

New federal regulations have been developed to address the production of disinfection by-products. A key component in the formation of disinfection by-products using chlorine disinfection is the mandated chlorine CT requirement to ensure a given pathogen kill. Removal of NOM in upstream treatment operations through the use of PAC would allow for longer disinfectant CT by decreasing the concentration of precursors that contribute to the formation of disinfection by-products.

The presence of NOM in water can pose a problem during the drinking water treatment process when it contributes to the formation of disinfection by-products such as THMs. The allowable levels of THMs in drinking water are currently regulated by federally mandated standards, and proposed changes to the standards are expected to further reduce allowable THM levels. The task of meeting these new standards will raise production costs significantly for many treatment plants. Small treatment plants will be particularly affected because they have relatively small customer bases to absorb cost increases.

Many different treatment operations have been evaluated for removal of NOM and/or reduction of THMs, including membrane processes, granular activated carbon, PAC, enhanced coagulation, and alternative disinfection processes such as ozonation and chloramination. Each of these processes has some merit; unfortunately, most require large capital expenditures and involve sizable operational costs. Of all the processes studied to date, PAC may offer the best cost-to-benefit alternative for small treatment plants.

A major advantage of using PAC for removal of NOM during water treatment is that it requires a relatively small cost expenditure to set up a PAC system compared to other process alternatives. In fact, many plants are currently using PAC for control of taste and odors and so already have a feeding system in place. PAC can be added to the water at a number of different points in the treatment plant, thus allowing some flexibility in the mode of operation. PAC can be used intermittently, as needed, during periods of high THM formation which reduces the treatment cost.

The main cost associated with the use of a PAC system to remove NOM from water is the cost of the PAC itself. In order to get the greatest cost benefit from the system, care must be taken to select the best PAC product for use in the plant. Several factors can impact the selection of a PAC. These include the site-specific performance of the PAC for reduction of taste and order, and NOM and THM formation potential, the cost of the PAC, and the ease of feeding the material.

Several research projects have reported on procedures useful for selecting specific types of PAC for removal of organics from water. Papers by personnel from the Manatee County, Florida, water treatment plant discuss work done to develop performance-based bid specifications for PAC (McLeod and others, 1993; McLeod and Simpson, 1993). The objective in these studies was to remove odor-causing organics. The following conclusions were drawn from these papers:

- The commonly used PAC adsorption indices and physical properties did not generally correlate with PAC performance.
- The tannin value was the best indicator of PAC performance, and an inverse relationship existed between tannin value and odorant removal.
- The initial odorant concentration had no effect on percent odorant removal.
- The presence of NOM decreased adsorption of odorants.
- A four-stage procedure involving development of dose–response curves, establishment of performance goals, calculation of dose–equivalent factors, and application of these factors to bid prices was an effective means of writing bid specifications for PAC.

- Other factors such as compatibility with other chemicals, handling, operator safety, treatment residual considerations, and delivery limitations should also be considered for effective bid specifications.

Research by personnel from the City of Edmonton, Alberta, water treatment plant studied removal of odor, color, DOC, and gasoline from water (Gammie and others, 1992). Although this work had a broader scope than the work done at the Manatee plant, many of the conclusions were similar. The following conclusions were drawn from this work:

- Carbon performance and ranking were not related to cost or to standard tests such as iodine number or phenol value.
- The "best" carbons performed well for removal of all parameters, thus different carbons are not needed for different organics events.
- Carbon ranking bore some relation to tannin values.
- Accumulation of PAC in an upflow clarifier, while resulting in high concentrations of PAC in the sludge, did not measurably improve removals.
- Removals and ranking of activated carbons may vary with water source and the types of organics; water plants should evaluate carbons on the raw water that they are treating for the parameters to be removed.

The projects done in Manatee and Edmonton both involved development of dose–response curves for a number of different PACs treating a site-specific water. This approach seemed to be sound and yielded useful information for a specific site. The usefulness of these studies is limited by the fact that in each case only one water was tested, making it impossible to draw conclusions about whether results obtained for one water type can be extended to other waters. The proposed research will study five different waters and attempt to draw correlations between water characteristics and PAC performance. Ideally, these correlations would allow smaller water treatment plants to select a cost-effective PAC for their own use without doing extensive testing and analyses.

Further, the studies done in Manatee and Edmonton did not vary major operational parameters such as water temperature and PAC contact time in their test plans. We believe that these parameters could significantly impact appropriate PAC dose and so should be varied in the evaluation procedure. Thus water temperature and CT have been included as variables in the testing matrix designed for the proposed research, and this means that, ultimately, they will be incorporated into the PAC dose–response relationship.

5.0 QUALIFICATIONS

The proposed project is a joint effort between the City of Grand Forks Water Treatment Plant, the UND Department of Civil Engineering, and the EERC. The EERC will assume the responsibility for overall project management. The Project Manager will be Mr. Dan Stepan who will be responsible for the overall technical direction of the program, monitoring project schedules and budgets, ensuring the timely completion of all project tasks, and contributing to and reviewing deliverables to ensure accuracy, clarity, and completeness. Mr Stepan is a Research Manager at the EERC with over 10 years of experience as a principal investigator and project manager on a variety of projects ranging from water and wastewater treatment to remediation of soils and groundwaters. He has a B.S. in Civil Engineering and an M.E. in Water Resource Management and Sanitary Engineering. Mr. Stepan is a member of the AWWA, the Water Environment Federation, and the American Society of Civil Engineers.

Ms. Hazel Fetters-Sletten and Mr. Craig Lacher, both of the City of Grand Forks Water Treatment Plant, will serve as Project Advisors as well as provide technical support. Ms. Fetters-Sletten, Superintendent of the Grand Forks Water Treatment Plant since 1991, supervises a 16.5-MGD lime-softening plant and a state-certified water and wastewater laboratory. Prior to becoming superintendent, Ms. Fetters-Sletten held the position of chemist in this laboratory (1985–1991). In addition, she has been involved in the following research projects:

- Technical Advisor for a Master's Thesis on developing a model to predict the most cost-effective blend of two surface waters while optimizing finished water turbidity, TOC, and hardness, Shichao Han, Department of Civil Engineering, University of North Dakota, 1995–1996.
- Technical Advisor for a Master's Thesis entitled "The Removal of Trihalomethane Formation Potential Using Granular Activated Carbon," Suda Kalikivaya, Department of Civil Engineering, University of North Dakota, 1992–1994.
- On-Site Coordinator for an Ozone Pilot Plant Study in cooperation with Dr. Charles Moretti, Department of Civil Engineering, University of North Dakota, 1994.
- Staff Coordinator for a Master's Thesis entitled "Evaluation of Grand Forks Water Treatment Disinfection Alternatives for Compliance with the Surface Water Treatment Rule," Department of Civil Engineering, University of North Dakota, 1990–1991, coordinating design of experimental protocol, laboratory techniques, and data analysis.
- Staff Coordinator for a study entitled "Chlorine Dioxide for Primary Disinfection, Taste and Odor Control, and Control of Disinfection By-Products at the Grand Forks Water Treatment Plant," 1992.

- Staff Coordinator for a study entitled "Optimization of Pretreatment for Reduction of THMFP at the Grand Forks Water Treatment Plant," 1991.
- Technical Advisor for a Master's Thesis entitled "Reduction of Trihalomethane Precursors at the Grand Forks Water Treatment Plant," Department of Civil Engineering, University of North Dakota, 1989–1990.

Ms. Fetters-Sletten's other activities include participation in the North Dakota Section of the AWWA as the Director for the state and several section committees; the Dakota Science Center Board of Directors, actively promoting hands-on science programs for elementary age children; the Water Environment Federation; and the North Dakota Water Pollution Control Conference. Ms. Fetters-Sletten holds a Master of Science in Microbiology from the UND School of Medicine and a Bachelor of Arts in Biology with a Minor in Chemistry from St. Cloud State University, St. Cloud, Minnesota.

Mr. Craig Lacher provides 20 years of laboratory experience, with the last seven years specifically in the water and wastewater field as a Chemist/Lab Supervisor for a state-certified environmental laboratory. Mr. Lacher has an A.A. degree in General Education, a Bachelor's degree in Chemistry, and is currently working on a Master's degree in Analytical Chemistry. Previous projects include specific work with THM analysis for studies involving chlorine dioxide, granular activated carbon, and preozonation evaluation for disinfection by-product control. Other pertinent projects include taste and odor profiling and analysis, predictive testing for THMs, and coordination and implementation of a laboratory data management system.

Publications and presentations include the following:

- "Sulfide Detection by Coulometric Argentometry," 1996
- "Arsenic and Selenium, A Modifier Approach to a Lower MDL," 1994

- "Water Plant Evaluation by P.C.," 1993
- "Overview of Lab Data Management System," 1992
- "TTHM Precursor Control Using Preozonation and GAC Columns," 1992–1994

Dr. Charles Moretti is an Associate Professor in the Civil Engineering Department at UND. His area of expertise is environmental engineering. In the past five years, Dr. Moretti has conducted several research projects in the area of drinking water treatment. Topics investigated include removal of NOM from water with granular activated carbon, the use of ozone as a primary disinfectant, reduction of chemical usage for water softening, and the use of various disinfectants for removal of biota from surface water. The major funding sources for this research were the City of Grand Forks, the North Dakota Water Resources Research Institute, and the Garrison Diversion Conservancy District. Dr. Moretti published three papers based on this research in national refereed journals.

Mr. Tom Moe is a Research Engineer in Environmental Remediation at the EERC. He received his M.E. in Environmental Engineering from UND in 1990 and his B.S. in Geological Engineering from UND in 1982. Mr. Moe has experience in the areas of water resource management, industrial wastewater treatment and reuse, and pilot- and bench-scale wastewater testing. Mr. Moe currently serves as the coordinator of the Red River Water Management Consortium (RRWMC) administered through the EERC. The RRWMC is composed of municipal, industrial, and rural stakeholders from within the Red River Basin and is committed to finding technical solutions to the water- and wastewater-related problems of its members. The ultimate goal of the RRWMC is to develop a water management strategy for the Red River Basin for the benefit of all. The proposed work has been included in the RRWMC Year 4 work plan for consideration of the members. The proposed work has the potential to benefit a number of current RRWMC members, and Mr. Moe will be involved in all aspects of the project, repreenting the interests of the RRWMC membership.

Dr. Edwin Olson is a Senior Research Advisor at the EERC. He received his Ph.D. in Chemistry and Physics from the California Institute of Technology in 1964. Prior to taking a position at the EERC, Dr. Olson taught chemistry and biochemistry at South Dakota State University and has also taught at the University of Notre Dame and Idaho State University. Dr. Olson's principal areas of interest and expertise include carbon and coal structure and reactivity, gas chromatography, liquid chromatography, organic trace analysis, mass spectrometry, infrared spectroscopy, and nuclear magnetic resonance spectroscopy. Dr. Olson is a member of several professional organizations, including the American Chemical Society and Sigma Xi. He has authored or coauthored over 120 publications.

6.0 VALUE TO NORTH DAKOTA

It is expected that this project will demonstrate the superior quality of activated carbon produced from North Dakota lignite with respect to TOC removal in water treatment processing, based on jar test results and demonstration-scale tests currently under way at the Grand Forks Water Treatment Plant. Also, Master's degree theses from UND provide encouraging results that indicate the applicability of North Dakota lignites for the production of activated carbon for water treatment.

There are over 4000 small- to medium-sized water utilities that could utilize a PAC product that is effective at limiting the formation potential of THMs. A unit operation making use of a quality PAC could be incorporated directly into the majority of these systems without significant process modifications. The market potential for a product such as this using conservative estimates, is 7000 tons per day, should the North Dakota lignite-derived PAC perform as expected.

7.0 MANAGEMENT

The overall project management structure is illustrated in Figure 1. The project manager, Mr. Dan Stepan, will be responsible for the overall coordination of the project. Ms. Hazel Fetters-Sletten and Mr. Craig Lacher, both of the City of Grand Forks Water Treatment Plant, will serve as project advisors, as well as provide technical and analytical support. Dr. Charles Moretti will also serve as a project advisor in addition to his active research role in various tasks. The rest of the project team, Dr. Edwin Olson, and Mr. Tom Moe, will serve as task managers for Tasks 1 and 3, respectively. Mr. Stepan will serve as task manager for Tasks 2, 4, and 5.

8.0 TIMETABLE

The proposed project will be conducted over a period of 18 months. A time line for the project is shown in Table 5.

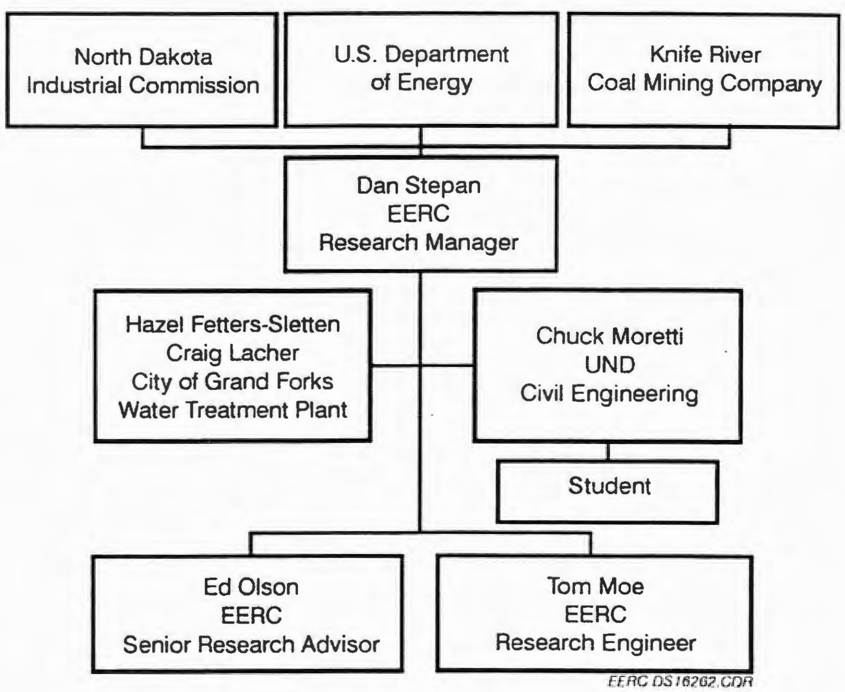

Figure 1. Management and project organization diagram.

Table 5. Project Time Line

	Year 1												Year 2					
Task	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
Task 1	■	■	■	■														
Task 2			■	■	■	■	■	■	■	■	■							
Task 3				■	■	■	■	■	■	■	■	■						
Task 4													■	■				
Task 5			■			■			■			■			■			■

9.0 BUDGET

The EERC is requesting NDIC to commit $60,000 of funding for this project. Once we have NDIC commitment, we will submit the proposal to DOE, requesting approval of its share of the funding.

Three items are required from NDIC for inclusion in our proposal to DOE:

- A formal commitment to the project. This can be a letter of commitment, a purchase order, or a signed contract.
- A biographical sketch or resume for the NDIC project manager and/or key technical contributor.
- A short overview of NDIC.

The EERC will submit a proposal to DOE for its approval upon receipt of NDIC commitment and the information noted above.

10.0 MATCHING FUNDS

The City of Grand Forks is extremely supportive of this project and has committed labor, technical support, and analytical services from its state-certified laboratory. City personnel will also serve as project advisors. The total estimated in-kind contribution from the City of Grand Forks is $60,000.

These funds will be matched with $60,000 from NDIC. This will subsequently be matched with DOE Jointly Sponsored Research Program funds of $40,000, available through the EERC, for a total project funding level of $160,000. A letter of support is included in Appendix B.

11.0 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.

12.0 CONFIDENTIAL INFORMATION

Confidential information is neither contained in this proposal nor anticipated as a result of these research activities.

13.0 REFERENCES

American Public Health Association, 1995, Standard Method for the Examination of Water and Wastewater, 19th Ed.

American Public Health Association, 1992, Standard Method for the Examination of Water and Wastewater, 18th Ed.

Gammie, L., Lee, T., and Rector, D.W., 1992, Choosing a powdered activated carbon: Presented at the Western Canada Water and Wastewater Association Conference, Calgary, Alberta, Canada October 4–16, 1992.

Hassler, J.W., 1967, Activated carbon: London, England, Leonard Hill.

MacLeod, B.W., and Simpson, M.R., 1993, Relationships between powdered activated carbon performance for geosmin and 2-methylisoborneol removal and common physical/adsorption indices: Presented at the American Water Works Association Water Quality Technology Conference, Miami, Florida, November 1993.

MacLeod, B.W., Simpson, M.R., and Zimmerman, J.A., 1993, Developing performance-based bid specifications for selected water treatment chemicals: Presented at the Florida Water Resources Conference, Orlando, Florida, November 1993.

SUMMARY BUDGET

POWDERED ACTIVATED CARBON FROM NORTH DAKOTA LIGNITE
NDIC/DOE
PROPOSED START DATE: 08/01/99
EERC PROPOSAL #99-0102 30-Apr-99

PROJECT TOTAL

	TOTAL		NDIC SHARE		EERC JSRP SHARE	
	HOURS	**$ COST**	**HOURS**	**$ COST**	**HOURS**	**$ COST**
TOTAL DIRECT LABOR	2429	$46,028	1389	$27,058	1040	$18,970
FRINGE BENEFITS - % OF DIRECT LABOR		$15,240		$9,240		$6,000
TOTAL LABOR		$61,268		$36,298		$24,970
OTHER DIRECT COSTS						
SUPPLIES		$2,000		$1,050		$950
COMMUNICATIONS - PHONES & POSTAGE		$357		$207		$150
OFFICE (PROJECT SPECIFIC SUPPLIES)		$500		$260		$240
GENERAL (FREIGHT, FOOD, MEMBERSHIPS, ETC.)		$850		$455		$395
FEES		$1,383		$691		$692
TOTAL OTHER DIRECT COST		$5,090		$2,663		$2,427
TOTAL DIRECT COST		$66,358		$38,961		$27,397
INDIRECT COST - % OF MTDC	VAR	$33,642	54%	$21,039	46%	$12,603
TOTAL EERC ESTIMATED COST		$100,000		$60,000		$40,000
CITY OF GRAND FORKS - IN-KIND COST SHARE		$60,000		$60,000		$0
TOTAL PROJECT COST		$160,000		$120,000		$40,000

NOTE: Due to limitations within the university's accounting system, the system does not provide for accumulating and reporting expenses at the Detailed Budget level. The Summary Budget is presented for the purpose of how we propose, account, and report expenses. The Detailed Budget is presented to assist in the evaluation of the proposal.

DETAILED BUDGET

POWDERED ACTIVATED CARBON FROM NORTH DAKOTA LIGNITE
NDIC/DOE
PROPOSED START DATE: 08/01/99
EERC PROPOSAL #99-0102

30-Apr-99

PROJECT TOTAL

LABOR	LABOR CATEGORY	HOURLY RATE	PROJECT TOTAL HOURS	PROJECT TOTAL $ COST	NDIC SHARE HOURS	NDIC SHARE $ COST	EERC JSRP SHARE HOURS	EERC JSRP SHARE $ COST
D. STEPAN	PROJECT MANAGER	$26.51	532	$14,103	350	$9,278	182	$4,825
C. MORETTI	FACULTY	$31.68	220	$6,970	130	$4,118	90	$2,852
T. MOE	RES. SCIENTIST II	$23.10	160	$3,696	88	$2,033	72	$1,663
E. OLSON	PRINCIPAL SCIENTIST	$35.45	44	$1,560	22	$780	22	$780
------------	SENIOR MANAGEMENT	$41.16	48	$1,976	28	$1,152	20	$824
------------	QUALITY CONTROL MANAGER	$21.85	11	$240	6	$131	5	$109
------------	RESEARCH TECHNICIAN	$14.78	90	$1,330	45	$665	45	$665
------------	GRADUATES-RES.	$10.00	1282	$12,820	700	$7,000	582	$5,820
------------	TECHNICAL SUPPORT SERVICES	$11.18	42	$469	20	$224	22	$245
			2429	$43,164	1389	$25,381	1040	$17,783
ESCALATION ABOVE CURRENT BASE				$2,864		$1,677		$1,187
TOTAL DIRECT LABOR				$46,028		$27,058		$18,970
FRINGE BENEFITS - % OF DIRECT LABOR		52%		$12,976		$7,923		$5,053
FRINGE BENEFITS - % OF FACULTY		25%		$1,854		$1,093		$761
FRINGE BENEFITS - % OF GRADUATES-RES.		3%		$410		$224		$186
TOTAL FRINGE BENEFITS				$15,240		$9,240		$6,000
TOTAL LABOR				$61,268		$36,298		$24,970
OTHER DIRECT COSTS								
SUPPLIES				$2,000		$1,050		$950
COMMUNICATIONS - PHONES & POSTAGE				$357		$207		$150
OFFICE (PROJECT SPECIFIC SUPPLIES)				$500		$260		$240
GENERAL (FREIGHT, FOOD, MEMBERSHIPS, ETC.)				$850		$455		$395
GRAPHICS				$1,383		$691		$692
TOTAL OTHER DIRECT COST				$5,090		$2,663		$2,427
TOTAL DIRECT COST				$66,358		$38,961		$27,397
INDIRECT COST - % OF MTDC			VAR	$33,642	54%	$21,039	46%	$12,603
TOTAL EERC ESTIMATED COST				$100,000		$60,000		$40,000
CITY OF GRAND FORKS - IN-KIND COST SHARE				$60,000		$60,000		$0
TOTAL PROJECT COST				$160,000		$120,000		$40,000

BUDGET NOTES

ENERGY & ENVIRONMENTAL RESEARCH CENTER (EERC)

Background

The EERC is an independently organized multidisciplinary research center within the University of North Dakota. The EERC receives no appropriated funding from the state of North Dakota and is funded through federal and nonfederal grants, contracts, or other agreements. Although the EERC is not affiliated with any one academic department, university academic faculty may participate in a project based on the scope of work and expertise required to perform the project.

The proposed work will be done on a cost-reimbursable basis. The distribution of costs between budget categories (labor, travel, supplies, equipment, subcontracts) is for planning purposes only. The principal investigator may, as dictated by the needs of the work, reallocate the budget among approved items or use the funds for other items directly related to the project, subject only to staying within the total dollars authorized for the overall program. The budget for this proposal has been prepared based on a specific start date; this start date is indicated at the top of the EERC detail budget or identified in the body of the proposal. Please be aware that any delay in the start of this project may result in an increase in the budget. Financial reporting will be at the total project level.

Salaries and Fringe Benefits

As an interdisciplinary, multiprogram, and multiproject research center, the EERC employs an administrative staff to provide required services for various direct and indirect support functions. Direct project salaries are estimated based on the scope of work and prior experience on projects of similar scope. Technical and administrative salaries are charged based on direct hourly effort on the project. For faculty, if the effort occurs during the academic year and crosses departmental lines, the salary will be in addition to the normal base salary. University policy allows faculty, who perform work in addition to their academic contract, to receive no more than 20% over the base salary. Costs for general support services, such as grants and contracts administration, accounting, personnel, purchasing and receiving, as well as clerical support of these functions, are included in the indirect cost of the EERC.

Fringe benefits are estimated based on historical data. The fringe benefits actually charged consist of two components. The first component covers average vacation, holiday, and sick leave (VSL) for the EERC. This component is approved by the UND cognizant audit agency and charged as a percentage of direct labor on permanent staff employees eligible for VSL benefits. The second component covers actual expenses for items such as health, life, and unemployment insurance; social security matching; worker's compensation; and UND retirement contributions.

Travel

Travel is estimated based on UND travel policies, which include estimated GSA daily meal rates. Travel includes scheduled meetings and conference participation as indicated in the scope of work.

Communications (Phones and Postage)

Monthly telephone services and fax telephone lines are included in indirect cost. Direct project cost includes long-distance telephone including fax-related long-distance calls; postage for regular, air, and express mail; and other data or document transportation costs.

Office (Project Specific Supplies)

General purpose office supplies (pencils, pens, paper clips, staples, Post-it notes, etc.) are provided through a central storeroom at no cost to individual projects. Budgeted project office supplies include items specifically related to the project: special research notebooks, binders, and other project organizational materials; duplicating, printing, special covers or paper, and binding of reports; project data forms, transparencies or other presentation materials; literature searches and technical information procurement, including subscriptions; manuals, computer diskettes, memory chips, laser printer paper, and toner cartridges; and other miscellaneous supplies required to complete the project.

Data Processing

Data processing includes items such as site licenses and computer software.

Supplies

Supplies in this category include scientific supply items such as chemicals, gases, and glassware and/or other project items such as: nuts, bolts, and piping necessary for pilot plant operations.

Fees

Laboratory and analytical fees are established and approved at the beginning of each fiscal year and are charged based on a per sample or hourly charge depending on the analytical services performed. Additionally, laboratory analyses may be performed outside the University when necessary.

Engineering support fees are based on an established per hour rate for drafting services related to the production of drawings as part of EERC's quality assurance/quality control program for complying with piping and pressure vessel codes.

Graphic services fees are based on an established per hour rate for overall graphics production such as report figures, poster sessions, standard word or table slides, simple maps, schematic slides, desktop publishing, photographs, and printing or copying.

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

General

Membership fees (if included) 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 as well as by the research team directly involved in project activity.

General expenditures for project meetings, workshops and conferences may include such items as food (some of which may exceed the institutional established limits), security, interpreters, technical tour transportation, and room and equipment rental necessary to conduct project meetings, workshops and conferences.

Indirect Cost

The indirect cost rate included in this proposal is the rate which became effective July 1, 1995. Indirect cost is calculated on modified total direct costs (MTDC). MTDC is defined as total direct costs less individual items of equipment in excess of $750 and subcontracts/subgrants in excess of the first $25,000 of each award.