December 7, 2007

North Dakota Industrial Commission
Attn: Renewable Energy Development Fund
State Capitol – Fourteenth Floor
600 East Boulevard
Bismarck, North Dakota 58505

Attached please find an application for Renewable Energy Development program funding, entitled: "The Development of Biojet Fuel from North Dakota Crop Oils".

For the past five years, SUNRISE researchers, under the direction of Principal Investigator Wayne Seames, have been researching technology to develop a commercially viable jet fuel from crop oils. The basic research for this technology is nearly complete and commercial partnerships have an interest in taking this technology to the marketplace. In order to maximize the market potential for biojet fuel, we must optimize the process using research results obtained in bench-scale and pilot-scale facilities. The proposed research project will allow us to conduct experiments that will use these facilities to define the design basis for an economical and competitive process. The UND biojet fuel process represents a new renewable energy technology and has the potential for substantial economic impact in North Dakota.

This proposal is submitted by the University of North Dakota on behalf of UND researchers in the SUNRISE research group. We confirm that this letter is a binding commitment on behalf of the University of North Dakota to complete the project as described in the attached application.

Barry Milavetz
Associate Vice-President for Research

Under N.D.C.C. § 44-04-18.4 trade secrets, proprietary, commercial and financial information is confidential if it is of privileged nature and not previously publicly disclosed.

North Dakota Industrial Commission
Renewable Energy Development Fund
December 1, 2007

Project Title: **Development of Biojet Fuel from North Dakota Crop Oils**

Name of Requesting Institution or Foundation: **The University of North Dakota SUNRISE Research Group**

Amount of Request: $500,000

Amount of Matching Funds: $570,000

Source of Matching Funds: Greenflight, LLC, UND

Campus contact person or principal investigator

Name: Wayne Seames

Title or Position: Associate Professor and Center Director

Mailing Address: Department of Chemical Engineering
University of North Dakota
241 Centennial Drive, Stop 7101
Grand Forks, ND 58202-7101

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Fax Number: 701-777-3773

E-mail Address: wayneseames@mail.und.edu

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Abstract

The objective of *"Development of Biojet Fuel from North Dakota Crop Oils"* is to support the research and development of biojet fuel utilizing crop oils (soybean and canola oil) as the primary raw material feedstock. For the past five years, SUNRISE researchers, under the direction of Principal Investigator Wayne Seames, have been researching technology to develop a commercially viable jet fuel from crop oils. The basic research for this technology is nearly complete and commercial partnerships have an interest in taking this technology to the marketplace. In order to maximize the market potential for biojet fuel, we must optimize the process using research results obtained in bench-scale and pilot-scale facilities. The proposed research project will allow us to conduct experiments that will use these facilities to define the design basis for an economical and competitive process. The UND biojet fuel process represents a new renewable energy technology and has the potential for substantial economic impact in North Dakota.

We propose to begin this one year project in June, 2008 at a total cost of $1,070,000, with $500,000 provided by the ND Industrial Commission, $544,000 by partners Diamond B, Bayer CropSciences, Northwood Mills, Crown Iron Works, and Global Agricultural Solutions through their commercialization company Greenflight, LLC, and $16,000 by UND. Bench-scale work will be performed in SUNRISE laboratories at UND while the pilot-scale system will be installed in the UND COE for Advanced Technologies & Life Sciences during the 1st half of 2008.

Specifically, we will complete bench-scale and pilot-scale optimization studies necessary to determine the basis for the design of a 3,000,000 gallon per year demonstration scale facility that will be installed at the Northwood Mills Soybean Crushing Facility. The studies performed under this project will evaluate process options, including by-product generation and catalyst selection. This work will also define process design parameters, such as reaction rates, reaction yields, purification requirements, and energy input requirements.

Project Description

Objectives

The purpose of "*Development of Biojet Fuel from North Dakota Crop Oils*" is to support the research and development of biojet fuel utilizing crop oils (soybean and canola oil) as the primary raw material feedstock. Specifically, we will evaluate and optimize key steps in the process we have previously invented. Our process utilizes cracking reaction technology to generate a suite of chemical components that can be processed into a kerosene-type fuel that can be used as a direct replacement for military JP-8 and commercial Jet A type aviation turbine fuels and as a direct replacement for diesel fuel no. 1, a cold weather transportation diesel engine fuel.

Background and Qualifications

PI Dr. Wayne Seames has led a group of researchers at the University of North Dakota in biojet fuel development for the past five years. The basic process is developed and a patent application has been submitted. The heart of this work is the conversion of crop oils using a technique known as cracking. Cracking simply means that molecules with many carbon atoms bonded together (for crop oil these are typically 18 carbons per branch, with three branches connected to a glycerol backbone per molecule – hence the term triglyceride) are cleaved forming molecules with a smaller number of carbon atoms. These smaller molecules are more amenable to producing fuels meeting existing specifications. Crop oils crack easily, making our process commercially attractive.

While cracking is a simple concept, crop oil cracking involves hundreds of reactions occurring in a single reactor. We have identified over 100 individual compounds in the cracking reaction product stream. The composition of the product stream generated during cracking can be manipulated using temperature, time, and gas phase reaction environment (inert, hydrogen, steam, etc.) and certain reactions can be encouraged through the use of specific catalysts. For example, one type of catalyst may maximize formation of linear hydrocarbons while another may maximize formation of cyclic hydrocarbons.

We have also performed extensive testing of preliminary prototype biojet fuel samples generated from soybean and canola oil. These tests indicate that combustion of JP-8/biojet fuel blends reduces the emission of particulates, CO, and hydrocarbons compared to pure JP-8.

Currently (December 2007), we are generating fuel samples that meet military specifications for JP-8 from both thermal and catalytic versions of the process. These will be submitted to the U.S. Air Force in mid-December for testing. After passing initial tests, our fuel will be added to a list of candidate fuels that will undergo certification testing in calendar year 2008. These qualification tests are a significant advantage for the UND team, as the Department of Defense has established a program for accelerated certification. After passing these tests, UND biojet fuel will be considered an acceptable fuel by the U.S. military, which consumes over 20 billion gallons of JP-8 per year.

Of course, it isn't enough just to make a fuel that meets specifications, it must be done in a cost effective manner that makes the process commercially viable. Thus an important next step in the development of this technology is process optimization. In order to conduct process optimization efficiently, each step in the process must be studied, first at the bench scale and then at the pilot scale.

This project will be conducted by the SUNRISE research group in cooperation with Greenflight, a joint venture company formed by UND and a suite of commercial partners for the purpose of commercializing SUNRISE biofuel technologies. SUNRISE is a faculty-led research group centered at UND but with participants from NDSU, NDSCS, and MaSU. SUNRISE increases the research productivity of 12 ND university system departments and develops technologies important to the energy and agribusiness sectors in ND.

Project Team. PI Wayne Seames is an associate professor of Chemical Engineering at UND. He is the Director of the SUNRISE research group and the Chief Science Officer of Greenflight. UND's 2007 Researcher of the Year, Dr. Seames also has 16 years of Industrial Experience including experience in project management and process engineering. He will have overall responsibility for the project and direct responsibility for all process optimization activities.

All senior SUNRISE personnel assisting in this project have been working on the predecessor research and development activities for at least three years. Participants and their roles are:

1. Co-PI Michael Mann, professor and chair of Chemical Engineering at UND, will oversee bench-scale system experiments and fuels analytical test equipment
2. Co-PI Darrin Muggli, associate professor of Chemical Engineering at UND, will oversee all catalyst related activities
3. Co-PI Alena Kubatova, assistant professor of Chemistry at UND, will oversee all analytical work required to support the experimentation on this project.

We anticipate using two graduate students and one professional analytical chemist to conduct portions of the work on this project.

After 14 months of careful evaluation and due diligence by UND and interested companies, we have formed a partnership with a group of companies dedicated to the commercialization of the UND biofuels technologies. An important factor in the selection of partner companies was their willingness to place processing facilities in North Dakota as well as their willingness to license the technology worldwide. Our partners are:

1. Diamond B Companies, managing partner; local facility developer and worldwide licensor

2. Northwood Mills, soybean crushing plant operator; supplier of soybean oil supplies and the site of the initial demonstration scale facility that will be built using the results of this project
3. Bayer Cropscience, supplier of canola oil supplies
4. Crown Iron Works, design and construction of the pilot plant used in this project
5. Global Agricultural Solutions, licensor of this technology for facilities outside of North America

Greenflight will provide personnel for the operation and maintenance of the pilot plant system used in this project, including a lead research engineer, a process engineer, and an instrument technician.

Methodology and Techniques

There are two primary process options we are developing, one based on thermal cracking (figure 1) and the other based on catalytic cracking (figure 2). The thermal cracking reaction step in the process is optimum when it produces the highest yield of biojet fuel components for the lowest energy input. The next step is removal of the light ends. Light ends are those chemicals that cannot be used in the final biojet fuel process because they have too high a volatility. Some of these, like propane, butane, and pentane, can be recovered and sold as valuable by-products. Others are like hydrogen, methane, and carbon monoxide and will be utilized as fuel gas to supply some of the energy for the process. The optimum step will remove the optimal quantity of light ends from the cracking reaction product mixture for the lowest energy input.

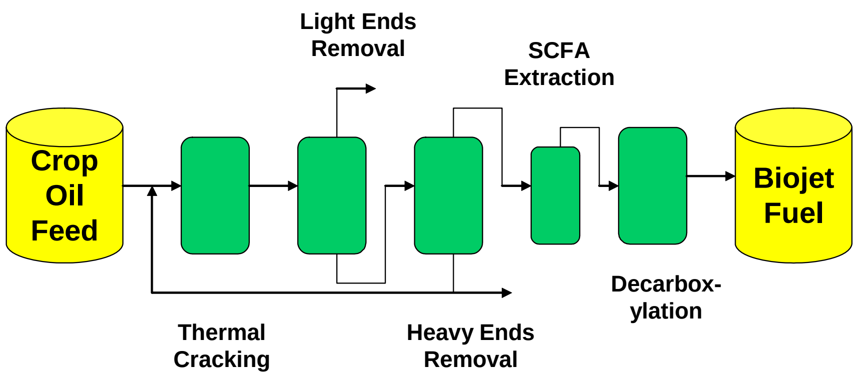

Figure 1. Biojet fuel from crop oil via the thermal cracking process

After light ends removal, the heavy ends are removed. Heavy ends are those chemicals that cannot be used in the final biojet fuel process because they have too high of a freeze point and/or too low of a heating value. Most are unreacted or partially reacted fatty acids that can be recycled back to the cracking reactor. Some of these may be extracted and recovered as valuable by-products. Others are very long-chain components that form a tarry substance similar to asphalt.

The thermal cracking process option generates a relatively high concentration of short chain fatty acids (SCFAs). These SCFAs are worth between 2- 20 times the value of biojet fuel. Extraction and purification of the SCFAs may make the process more economical. The extraction step for removing the SCFAs from the biojet fuel mixture must be optimized. The optimum SCFA extraction step will maximize SCFA removal, minimize the removal of unwanted chemicals, have minimum degradation of the extraction solvent, and have the lowest energy input for regeneration of the extraction solvent.

After extraction, residual fatty acidss left in the biojet fuel must be converted into hydrocarbons in order to reduce the corrosion potential of the fuel (reduce it's acidity as measured by an acid number). This process is known as decarboxylation because the reaction removes the acid group (known as a carboxylic acid group) from the hydrocarbon portion of the molecule. Decarboxylation is a catalytic reaction that must also be optimized to maximize the conversion of SCFAs, minimize the generation of unwanted side reaction products, have the longest catalyst life, and have the lowest energy input.

The catalytic cracking process option, shown in figure 2, is similar to the thermal cracking process but utilizes catalysts in the first step to fine tune the cracking reaction and to carry out decarboxylation in the same step. Catalysts are materials used to facilitate a chemical reaction. The optimum catalytic cracking reaction step will produce the highest yield of biojet fuel components, have the longest catalyst life (prior to regeneration or replacement), and have the lowest energy input.

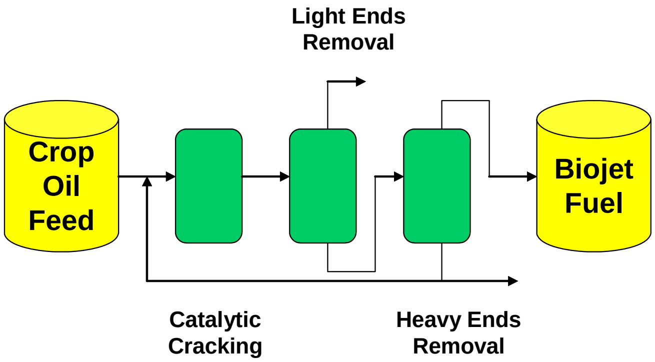

Figure 2. Biojet fuel from crop oil via the catalytic cracking process

Thus, the specific work tasks that will be accomplished in the proposed project are summarized as follows:

1. Optimize the thermal cracking of soybean oil for the production of biojet fuel
2. Optimize the thermal cracking of canola oil for the production of biojet fuel
3. Evaluate alternative catalysts for the cracking of soybean and canola oil
4. Optimize the purification of cracked oil for the production of biojet fuel for each cracking reaction process option (cracking type, oil feedstock, etc.)
5. Optimize the decarboxylation to produce biojet fuel for each cracking reaction process option
6. Optimize the extraction of short chain fatty acids from purified thermally cracked oil

Optimization tests will be performed by identifying the key parameters affecting the performance of the specific unit operation. For example, the cracking reactor performance will depend on operating temperature and pressure, residence time, feed temperature, the presence or absence of a cracking agent such as hydrogen, steam, or another gas. Optimization tests will be primarily performed using a bench-scale system (see facilities, below). Design of experiment methodologies will be utilized to insure that the most efficient set of experiments is conducted. Because of the extensive amount of analytical work required to support these tests, we will use performance test parameters, such as heating value and freeze point in the bulk of the parametric tests and only perform a rigorous quantification of the chemical composition of product streams for a selected subset of the tests performed.

In the extraction tests, we will evaluate at least three potential solvents: water, NaOH, and an amine (such as monoethanol amine, MEA) independently and in combination (multi-stage extraction). Key parameters include extraction temperature, solute/solvent ratio, solvent degradation rate, and regeneration capabilities. The goal is to maximize extraction of valuable C2-C10 fatty acids while minimizing extraction of other components from the biojet fuel mixture.

Catalyst evaluation tests will be performed, based on preliminary results already obtained, to determine the best specific catalyst for this application. The doping of certain metals onto the surfaces of activated alumina (the base catalyst we have been working with), is expected to increase the selectivity of the cracking reaction. Further, preliminary tests have shown that a two stage cracking process in which HSM-5 zeolytic catalyst is used in a second stage after activated alumina may increase the yield of the cracking reaction. These concepts will be explored and then used in optimization testing.

Pilot scale testing will be used to validate the bench-scale results by testing variations in only the most significant (as determined by the bench-scale tests) factors. These tests will also be used to assess catalyst deactivation and poisoning.

Anticipated Results and Standards of Success

At the completion of this project we will have fully defined the process parameters necessary to design and construct demonstration scale biojet fuel facilities based on either of two cracking options: thermal cracking with by-product SCFA production and catalytic cracking. These data will be evaluated economically and technically to determine which process will be used in the initial demonstration scale facility, a three million gallon per year plant that will be located and operated adjacent to the Northwood Mills soybean crushing plant in Northwood, ND.

Facilities and Resources

The bulk of the experiments needed to complete these tasks will be performed using our existing 0.5 gallon per hour bench-scale continuous biojet fuel system. Using this system we can perform a large number of experiments at varying conditions relatively quickly and inexpensively (compared to the pilot scale testing). The system is fully instrumented and conditions can be varied in order to explore and optimize the process conditions. This facility is located in SUNRISE laboratories on the UND campus and is supported by UND technicians and faculty engineering personnel.

The pilot scale system, a 30 gallon per hour continuous system, will be designed and constructed in the first half of 2008 by Greenflight. It will be utilized in this project to validate bench-scale optimal results and to make final process parameter adjustments due to scale up. This system will also be used for catalyst deactivation and fouling studies. This facility will be located in the UND COE for Advanced

Technologies & Life Sciences building. Dr. Seames has designed an area of this building specifically for the conduct of this pilot plant research. Greenflight personnel are housed in the UND Technology Incubator building located adjacent to the pilot plant facility.

A full suite of analytical instruments and capabilities support this project. These include gas chromatographs with flame ionization and mass spectrometric detection for identification and quantification of chemical compounds, cloud/pour/freeze point analysis, heating value analysis, acidity measure, and flash point analysis. These instruments are located in SUNRISE laboratories on the UND campus and are supported by UND instrument technicians and faculty chemistry personnel. Three key instruments not currently available locally will be purchased under this project, a "water in oil" tester, a distillation profile apparatus, and a copper corrosion tester.

Work will be conducted by a mix of student and full-time engineering and chemistry staff under the overall direction of PI Wayne Seames and specialized direction of the three co-PIs.

Environmental and Economic Impacts

This project will have minimal environmental impact during implementation. Execution of this project will reduce investment risk for Greenflight partners by leveraging their investment in development activities. This in turn, increases the probability of successful commercial venture success.

Ultimate Technological and Economic Impacts

This project represents a necessary next step for the technology development necessary to commercialize North Dakota-based biojet fuel technology. Greenflight partners expect to build at least three facilities within North Dakota: a 3 million gallon per year facility in Northwood based on soybean oil, a 30-50 million gallon per year facility in North Central North Dakota based on canola oil, and a 30-50 million gallon per year facility in Southeastern North Dakota based on soybean oil. These facilities will provide an estimated 275 high paying jobs for the adjacent rural communities as well as over 1800 associated service sector jobs.

Worldwide licensing of the technology is also expected. Greenflight partner Global Agricultural Solutions intends to use this technology for facilities in Western Africa and Europe. Heartland Bioresources has preliminary plans to build a 10 million gallon per year facility in Manitoba, Canada using our biojet fuel technology and canola oil feedstock.

The U.S. Department of Defense has indicated a desire to contract for substantial quantities of biojet fuel from certified suppliers. This includes supply to both North Dakota air bases. Local distributors have indicated a desire to purchase substantial quantities of cold flow capable biodiesel which these facilities will be capable of producing.

In short, this project can assist in making North Dakota a world leader in the production of biojet and cold flow biodiesel.

Management Plan, Timetable, and Reporting

Technical management will be conducted by PI Wayne Seames. Dr. Seames heads both the academic research team and the commercial development team participating on this project, thus ensuring effective coordination and control. Technical team roles are defined under the Background and Qualifications section beginning on page 6. Financial management of this grant will be performed by the UND Grants and Contracts administration office, which is staffed by experienced financial contracts personnel.

A summary project schedule is shown in figure 3. Per section REC-5.11, interim and final reports will be completed per the final terms of the contract. We anticipate that, consistent with Federal grants of similar nature and duration that interim reports will consist of quarterly financial reports and separate quarterly summary progress reports. Due to the commercially valuable nature of the data generated in this project, all technical reports will be issued under condition of confidentiality and the final data will not be published or disseminated but be retained by Greenflight in order to maximize the probability of effective commercialization of the technology.

ID	Task Name	Start	Finish	Predecessors
1	Project Start	Mon 6/2/08	Mon 6/2/08	
2	Optimize thermal cracking step	Tue 6/3/08	Mon 9/15/08	1
3	Optimize thermal cracking purification steps	Tue 9/16/08	Mon 10/27/08	2
4	Optimize thermal cracking extraction steps	Tue 9/16/08	Mon 3/2/09	2,3FF+10 days
5	Optimize thermal cracking decarboxylation step	Tue 11/11/08	Mon 3/16/09	4FF+10 days,2,3
6	Thermal process pilot scale verification tests	Tue 3/17/09	Fri 5/8/09	5
7	Thermal process optimization complete	Fri 5/8/09	Fri 5/8/09	6
8	Optimize catalytic cracking step	Tue 9/23/08	Mon 12/15/08	2FS+5 days
9	Optimize catalytic cracking purification steps	Tue 12/16/08	Mon 1/26/09	8
10	Catalytic process pilot scale verification tests	Tue 1/27/09	Mon 3/9/09	9
11	Catalytic process optimization complete	Tue 3/10/09	Tue 3/10/09	10
12	Write final report	Mon 5/11/09	Thu 5/28/09	7,11
13	Project end	Thu 5/28/09	Thu 5/28/09	12

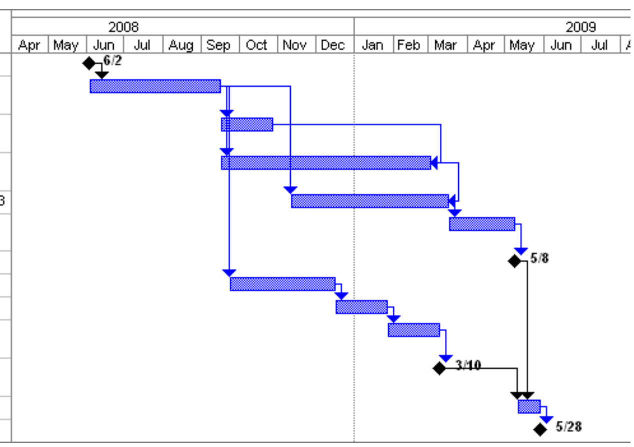

Figure 3. Project Schedule

Budget

The budget for this project is provided in appendix A, along with associated notes explaining each budget category. Greenflight commercial partners have committed to provide cash or in-kind equivalents (personnel from Greenflight) in the amount of $554,000, which exceeds the 1:1 match requirement of the grant. UND provides an additional $16,000 in-kind match in the form of a graduate tuition waiver.

Tax liability: Not applicable since UND is part of the State of North Dakota governmental entity.

Confidential information: UND requests that the entire contents of this proposal, excluding the abstract, be kept confidential.

Patents and Rights to Technical Data: This project utilizes intellectual property already owned by the University of North Dakota. We reserve all rights to intellectual property and data generated during the course of this project.

Letters of support: Due to space limitations, letters of support from the commercial partners are not included. However, these letters are available upon request. Additional letters of support from the University of North Dakota and the North Dakota Soybean Council are also available upon request.

APPENDIX A: BUDGET SUMARY

PERSONNEL EXPENSES	NDIC	Commercial Match	UND Match	TOTAL
SALARY - Faculty	$72,722	$11,733		$84,456
FRINGE BENEFITS-faculty	$18,181	$5,280		$23,461
SALARY - Graduate Students	$88,000	$0		$88,000
FRINGE BENEFITS-Grad	$3,000	$0		$3,000
SALARY-Undergrad Students	$0	$0		$0
SALARY - Other Employees	$0	$235,000		$235,000
FRINGE BENEFITS-Other	$0	$105,750		$105,750
TOTAL PERSONNEL	$181,903	$357,763		$539,666
				$0
OPERATING EXPENSES				$0
TRAVEL - Travel	$2,000	$0		$2,000
Copies- Other	$500			$500
Postage - Other	$200			$200
RENTS & LEASES - Other	$0	$191,500		$191,500
OFFICE - Supplies	$1,000	$0		$1,000
Clothing - Other	$200			$200
Research SUPPLIES - Supplies	$91,435	$4,994		$96,429
FEES - Other				$0
SUBCONTRACTS				$0
INSTRUCTIONAL - Supplies				$0
GENERAL - Other				$0
TOTAL OPERATING EXPENSES	$95,335	$196,494		$291,829
				$0
EQUIPMENT				$0
Karl Fisher Titrator	$8,000			$8,000
Vacuum distillation	$65,000			$65,000
Copper corrosion tester	$5,500			$5,500
TOTAL EQUIPMENT COSTS	$78,500			$78,500
				$0
TOTAL DIRECT COST	$355,738	$554,257		$909,995
F&A Costs @ 35.0	$97,033			$97,033
Cost of Education Allowance	$47,229	$0	$15,743	$62,971
				$0
TOTAL PROJECT COSTS	**$500,000**	**$554,257**	**$15,743**	**$1,070,000**

Due to the limitations within the Universities accounting system, the system does not provide for accumulating and reporting of expenses at the detail level outlined above. The costs will be accounted for and reported at the category level. The detail above is presented for proposal evaluation purposes only.

BUDGET NOTES

This budget is based on a project starting date of June 1, 2008 and a completion date of May 31, 2009.

Administrative Systems:
The University of North Dakota has established systems for the effective administration of programs sponsored by external agencies. As with all sponsored programs, the Principal Investigator will be responsible for the overall administration and progress of the project. The GCA office is responsible for submitting all required financial reports to all sponsoring agencies. Support for all expenditures including original invoices, payment vouchers, etc. will be maintained by the University. In addition, the GCA office will supply the Principal Investigator with monthly reports comparing the project's original budget with expenditures to date. The University of North Dakota is included in the statewide single audit in accordance with OMB Circular A-133, Audits of States, Local Governments, and Non-Profit Organizations. A report is issued every other year.

A. Senior Personnel: NDIC funds will be used for all UND personnel associated with the project. One month of salary is included for each of the co-PIs, Drs. Mann, Muggli, and Kubatova. Some of the work performed in the conduct of this project may be above and beyond that expected for this job position. The funds requested may include salaries in compensation for overload, not to exceed 20% of the full time load. Salary is based on 2007/08 academic year salary with a salary escalation of 5%. NDIC funds will be used to provide full-time (12 months per year) salary for an analytical chemist, hired by UND, to perform the analytical work associated with this project. Also included is 10% of the salary for an administrative assistant. The budget includes twelve month graduate research assistantships for four masters and doctoral students working on the project. The stipend is based on 2007/08 rates escalated by 9%.

B. Fringe Benefits: are estimated at a composite average of 25% of salary for UND faculty and staff positions. Graduate student benefits were calculated at $750 per calendar year. Amounts shown for fringe benefits are estimates determined by historical data and are provided for proposal evaluation purposes only. Actual fringe benefit costs will be charged to the grant according to each employee's actual benefits.

C. Travel: is estimated on the basis of UND travel policies which can be found at: http://www.und.edu/dept/accounts/employeetravel.html. Estimates include General Services Administration (GSA) daily meal rates. Travel funds are provided to support incidental travel required to support the research efforts of the project and for anticipated meetings with NDIC personnel in Bismarck.

D. Materials and supplies: are included to support R&D activities to perform the scope of work. These include laboratory supply items, minor equipment items, and UND owned instrument maintenance and repair costs. Costs in this category include but are not limited to chemicals, consumable lab supplies, labware, consumable gases, consumable raw materials, minor equipment, and any other supplies necessary to perform the experimental activities as well as for nuts, bolts, piping, tools, and other similar material and resources necessary to fabricate, repair, and operate the experimental equipment necessary to perform the work.

E. Clothing: included are the costs for coveralls, work boots, hard hats, safety glasses, hearing protection, respirators and any other personal protection equipment necessary to safely perform the work.

F. Office supplies: include items specifically related to the proposed project and may be such items as pens, pencils, paper clips, printer paper and toner cartridges, notebooks (if needed), Post-It notes, computer diskettes, transparencies or other presentation materials, duplicating materials or charges, and other miscellaneous items required to complete the project.

G. Copies and duplicating costs: are included that directly support this project.

H. Postage costs: are included that directly support this project

I. Tuition waivers/cost of education allowances: cost of education allowances are included for three of the four graduate students that will be supported under this project. Values are based on graduate school published 2007/08 rate of $14,443 escalated at 9%. A ChE department tuition waiver will be used for the fourth student.

J. Capital Equipment: Three test instruments will be purchased that directly supported the work scope of this project: Karl Fisher Titrator = $8,000; Vacuum distillation=$65,000; Copper corrosion tester=$5,500. Values are based on vendor quotes and include shipping and handling. Actual prices from updated quotations at the time of purchase may vary.

K. Indirect Costs: Indirect costs, charged at the rate of 35.0%, which is the rate approved by the Department of Health and Human Services (effective July 1, 2005). 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 subcontracts/subgrants in excess of the first $25,000 for each award and cost of education allowances.

L. Cost Share: the total estimated value of matching funds to NDIC funding is $570,000

1. The commercial partners, through Greenflight, will provide an estimated $554,300 in cash or cash equivalent cost share. Cost share funds are allocated per the follow estimates:
    a. Personnel: $358,300 to cover the salaries and fringe benefits for full time participation by a Lead Research Engineer, a Research Engineer, an Administrative Assistant, and an Instrument Technician.
    b. Materials and Supplies: $5000
    c. Pilot System User fee: $70,000 based on 70 days of testing at $1000 per day which includes all operating and maintenance costs associated with the pilot system
    d. Pilot lab rental fee: $121,000 to cover one year's rental costs for the space used in the Advanced Technology laboratory building. While testing may only take 70 days, the space in the system must be provided for the entire duration of the project.

2. The University of North Dakota will provide one tuition wavier valued at $15,700.

APPENDIX B: RESUME OF PI Wayne Seames

Associate Professor, Department of Chemical Engineering
University of North Dakota (UND)
PO Box 7101, Grand Forks, North Dakota 58202-7101 USA
Phone (701) 777-2958; Fax (701) 777-3773; E-Mail: WayneSeames@mail.und.nodak.edu

PRINCIPAL AREAS OF EXPERTISE

Dr. Seames is an expert in sustainable energy technologies including the invention and development of fuels and chemicals from crop oils and coal; the environmental impact and remediation technologies of both organic and inorganic chemicals. He has extensive project management and design engineering experience as well as industrial management, supervision, and process/environmental engineering experiment. Other areas of expertise: Project Management, Technology Projects, Automation Technologies, Process Plant Automation, Safety Management, Safety Systems Design, Process Engineering, Applied Process Control, New Process Feasibility Studies, Productivity Studies. Dr. Seames teaches senior level project engineering and process plant design courses plus design and operational safety concepts.

EDUCATION

2000 Ph.D. Chemical Engineering, University of Arizona
1979 B.S. Chemical Engineering, University of Arizona

PROFESSIONAL EXPERIENCE

Twenty-five years of experience in energy and environmental research, project engineering, engineering management/supervision, energy engineering, environmental engineering, process control/automation, process design, and process safety in academic, industrial, and consulting positions.

2004 – Present	Associate Professor, Department of Chemical Engineering University of North Dakota, Grand Forks, ND
2000 – 2004	Assistant Professor, Department of Chemical Engineering, UND
1995 – Present	Independent Consultant, Seaway Consulting
	Graduate Instructor/Research Assistant, Dept. of Chemical, Engineering, University of Arizona, Tucson, Az.
1992 – 1995	Project Manager, Refinery Expansion Project, Saudi Arabian Oil Company, Dhahran, Saudi Arabia
1988 – 1992	Supervisor, Ras Tanura Refinery Engineering Dept., Saudi Arabian Oil Company, Ras Tanura, Saudi Arabia
1985 – 1988	Operations/Project Engineer, Ras Tanura Refinery Eng. Dept., Saudi Arabian Oil Company, Ras Tanura, Saudi Arabia
1982 – 1985	Process Engineer, Engineering Dept., Aramco Services Co., Houston, Tx.
1979 – 1982	Chemical Engineer, Engineering Dept., Radian Corp., Austin, Tx.

OTHER ACCOMPLISMENTS

2007 UND Award for Excellence in Individual Research (University Researcher of the Year); 2006 UND School of Engineering and Mines Professor of the Year (Outstanding teacher); "Award for Excellence at the Student Interface" from the Univ. of Arizona College of Engineering and Mines, 1999 (Outstanding faculty teaching award); 2004-2005 Olson Professor for Excellence in Research and Scholarship, UND SEM.

Director, Sustainable Energy Research Initiative and Supporting Education (SUNRISE): 2007-present; Coordinating Faculty Member: 2004-2007

PUBLICATIONS

Over 20 peer-reviewed publications; 5 submitted patent applications; over 120 public/private reports.

Corporan, Edwin; Reich, Richard; Monroig, Orvin; DeWitt, Matthew J.; Larson, Venus; Aulich, Ted; Mann, Michael; **Seames, Wayne**, "Impacts of Biodiesel on Pollutant Emissions of a JP-8--Fueled Turbine Engine", Journal of the Air & Waste Management Association Jul 2005, 55, p940-949.