minnesota power / 30 west superior street / duluth, minnesota 55802 / telephone 218-722-2641

Thomas A. Micheletti - group vice president - general counsel and secretary

March 30, 1989

Mr. Tim Kingstad
State Land Commissioner
State Capitol
Bismarck, North Dakota
58505

Dear Mr. Kingstad:

RE: Lignite Research Council Grant Application

Minnesota Power and Baukol-Noonan, Inc. are pleased to submit the attached application for an LRC grant. We are enthusiastic about the potential of North Dakota lignite that has been beneficiated with the "hot-water-drying" process: the subject of our application.

Please find attached five copies of the LRC grant application. If there are any questions or comments, feel free to contact the project's principle investigator, Mr. George Nehls, at tel: 218-722-2641. We look forward to discussing our project with you in the near future.

Sincerely,

Thomas A. Micheletti
Minnesota Power
Group Vice-President
General Council

Charles M. Reichert
Baukol-Noonan, Inc.
President, Elect

GRN:wjo

Attachment

CC: J. G. Miller
Coal Beneficiation

Hot Water Drying of North Dakota Lignite

Grant Application to the
North Dakota Lignite Research Council

for the amount of $70,000

submitted by,

Baukol-Noonan, Inc.
&
Minnesota Power

date of submission,
March 31, 1989

Principle Investigator,
George R. Nehls Jr.
tel: 218-722-2641

Project Summary

Baukol-Noonan, Inc. and Minnesota Power are investigating the potential of applying the thermochemical process known as "hot-water-drying" to up-grade, or beneficiate, North Dakota lignite. The expected result of this project is the creation of a new industry which will market beneficiated North Dakota lignite for use in utility boilers both within and outside of North Dakota. The project may involve the application for DOE Clean Coal Technology co-funding.

Baukol-Noonan, Inc. and Minnesota Power are proceeding on a pilot-scale research and development program which will determine the technical and economic feasibility of the hot-water-drying process at the commercial-scale, and to provide key data for the requirements of the DOE Clean Coal Program application. When the pilot-scale program is completed, DOE Clean Coal Technology co-funding may be applied for to assist in the demonstration of the technology. Because the requirements of the DOE CCT application are well defined, this grant application is primarily directed towards the details of the pilot plant test program.

Baukol-Noonan, Inc. and Minnesota Power's intent in applying for Lignite Research Council co-funding is to help defray the high costs experienced in the pilot test program and the DOE Clean Coal Technology application; a grant of **$70,000** is being requested. The estimated gross cost of the project is **$670,000**, including the cost of applying for the DOE Clean Coal Technology co-funding. Of these costs, detailed estimates of **$450,000** are available; the cost of applying for the CCT funding is estimated to be **$220,000**.

The project was initiated at the beginning of 1989 and is expected to continue through December 26, 1989 when the DOE's selections will be made public. Following this date, a new schedule with the next round of tasks will become effective. Activities being undertaken at this time include detailed pilot plant testing. This pilot plant work involves the:

- Bench scale characterization of waste streams based on North Dakota lignite, waste stream treatment options, and ash fouling potential of the lignite fuel product. This work has been performed by North Dakota's Energy and Mineral Research Center (EMRC).
- Production of sufficient quantities of hot-water-dried North Dakota lignite for fire-side performance testing, along with process data acquisition. This work has been performed by the Electric Power Research Institute (EPRI), and the Institute of Gas Technology (IGT).
- Boiler performance testing of the fuel product. This work will be performed primarily by Combustion Engineering, with additional work performed by EMRC.

The pilot plant test work will be completed by May 15, 1989. The testing will provide the technical and economic data required in the CCT application. The DOE Clean Coal Technology application, if appropriate, will be completed in the time frame between May 16, 1989 and August 15, 1989.

The major participants in the project (although not necessarily as project participants in the demonstration plant) are: Baukol-Noonan, Inc., Minnesota Power, North Dakota EMRC, EPRI, IGT, Combustion Engineering, and Bechtel National, Inc., which has been retained to assist in the engineering analysis.

Table of Contents

	Page
Objectives	1
Background	2
Goals	3
Methods	4
Timetable	9
Personnel	11
Qualifications	13
Budget	14

Objectives

The objectives of Baukol-Noonan and Minnesota Power's lignite beneficiation project can be summarized as follows:

- The ultimate objective of the project is to economically up-grade, or beneficiate, North Dakota lignite to an export quality boiler fuel. An additional application may be found in blending the beneficiated lignite with raw lignite for use in sodium-limited boilers. This will require the construction and operation of at least one commercial-scale lignite processing plant following successful development of the beneficiation process under consideration.

- The intermediate objective of the project is the design, construction, and successful operation of a demonstration-scale lignite beneficiation plant. It is anticipated that co-funding would be applied for through the DOE's Clean Coal Technology Program (Phase III), and others. The purpose of the demonstration plant would be to provide a means to complete process development at a scale large enough to permit full-scale boiler testing of the beneficiated lignite. The beneficiated lignite would be tested in applications by interested parties up to and including large utility boilers.

- The near term objective of the project is to execute bench-scale and pilot-scale testing, the results of which will support the data requirements of the Clean Coal Technology (CCT) application.

Utilization of lignite is currently limited due to its high moisture content, and other undesirable qualities, such as high sodium content, and tendencies to decrepitate, dustiness, and spontaneously ignite following exposure after mining. The hot-water-drying process under consideration appears to simultaneously reduce all of the above undesirable features. The end product is expected to be a high grade boiler fuel with stabilized physical characteristics. However, prior to committing large investments toward demonstration level development, detailed pilot-scale experimentation and economic analyses must be performed. In meeting the near-term objective of process analysis at the bench/pilot-scale, the assistance of LRC funding will help provide the basis for expanded lignite marketability, to include the establishment of a new lignite export industry.

Details of the test program are given in the section entitled: **Methods**.

Background

Minnesota Power has been investigating coal beneficiation processes for a number of years. The most recent efforts have been directed at up-grading raw lignite into a product suitable for utilization in utility sized boilers that were originally designed for burning a higher rank coal. Minnesota Power has been investigating the process known as "hot-water-drying" of low rank coals since early 1986. Baukol-Noonan has provided valuable information regarding lignite characteristics and resource availability. Bechtel National, Inc. an Architect & Engineering firm, has considerable experience in coal beneficiating processes. Bechtel National Inc., has been retained by Baukol-Noonan and Minnesota Power to assist in this project.

Hot-water-drying is a thermochemical means of improving, or beneficiating, low-rank coals such as lignite. The process has the potential to economically transform raw lignite into an exportable fuel product. The product may be marketable as a replacement fuel for utility boilers currently firing higher sulfur content coals.

The primary benefit derived from hot-water-drying a low-rank coal is improved heating value, which results from reducing the moisture and oxygen contents of the coal. For example, raw lignite characteristically has a heating value of 7000 Btu/lb, a moisture content of 35%, and an oxygen content of 12%. After hot-water-drying, the product lignite may be expected to have a heating value of 10,500 Btu/lb, a moisture content of 12%, and an oxygen content of 7%. The improvement in heating value results because water and oxygen content both contribute nothing to the heating value of the lignite: hence they are termed weighty impurities.

Another significant benefit derived from hot-water-drying lignite is that the process has the potential to significantly reduce the lignite's sodium content. Sodium can have seriously detrimental effects on the ability to cleanly burn lignite in a combustion process. Many operators of lignite fueled boilers have become familiar with boiler fouling and forced outages due to high sodium content in the lignite. The fouling effect on boilers designed for higher rank coals can be even more serious. Hot-water-drying is almost unique among commercially attractive coal processes in its ability to reduce sodium content by as much as 85%, although 50% should be considered more the norm.

Other benefits resulting from the hot-water-drying process are improved fuel stability, resulting in reduced spontaneous combustion tendencies, and reduced tendency of the lignite to break down into dusty fine particles.

The hot-water-drying process makes use of a fundamental process which runs counter to intuition. A low rank coal, such as lignite, is immersed in water, pressurized, and heated for a short period of time. The temperatures used are usually in the range from 260° C to 320° C.

The pressure must be maintained high enough to prohibit the water surrounding the coal from boiling: hence the term hot-water drying. Under these process conditions water is forced out of the coal particle, rather than into the coal particle. Keeping all water in the liquid phase during the process has another desirable side effect: since evaporating water (energy requirement about 1000 Btu/lb) is avoided, the process is inherently energy efficient. The fact that evaporation is avoided is particularly important when higher moisture content coals are the feedstock. For example, reducing the moisture content of a ton of lignite from 35% to 10% requires the removal of over 550 lbs of water. The energy required to evaporate this is substantial. As a result, hot-water-drying requires generally one-third to one-fourth of the energy of a conventional coal-drying process. In addition, liquid water is produced as a process byproduct, which may have value in arid regions.

Although a relatively large body of information regarding the characteristics of hot-water-dried lignite exists at the laboratory scale, no evidence exists of performance testing under simulated utility boiler conditions. Key issues such as ash emissivity, fuel reactivity and burn-out, boiler fouling and slagging potential, and pulverizer performance must be determined prior to making a commitment to a demonstration-scale facility. The proposed test program addresses these issues. Execution of this test program is expected to define the capabilities of the beneficiated lignite for most utility-scale boilers originally designed for operation on bituminous and subbituminous coal.

Without detailed performance testing, it is unlikely that enough confidence would exist in the characteristics of the beneficiated lignite for a potential developer to commit to a demonstration of the technology.

Much of the fundamental development of hot-water-drying processes has occurred at the North Dakota Energy & Mineral Research Center in Grand Forks, ND.

Goals

- The general goal of the proposed pilot plant test work is to determine the feasibility of hot-water-dried North Dakota lignite as a replacement boiler fuel for western subbituminous and eastern bituminous coals.

- The specific goals of the proposed project are to determine the expected performance of the beneficiated lignite by determining its:

    1) Handling and Pulverization Characteristics
    2) Combustion Characteristics
    3) Ash Deposition Characteristics
    4) Emissions (for environmental considerations)

More detail about these goals is given in the next section: **Methods**.

Methods

The overall project may involve the application for DOE Clean Coal Technology co-funding to design, construct and operate a demonstration of the hot-water-drying technology. In order to obtain the necessary data required for the DOE CCT application, a detailed pilot test program must be accomplished. This test program is described below.

Test Program Description

The overall purpose of the pilot plant test program is to simulate the performance of the beneficiated lignite in a pulverized coal utility-scale boiler. The performance test work will be performed by Combustion Engineering at its Fireside Performance Test Facility in Windsor, Connecticut. The test program involves the combined efforts of Baukol-Noonan, Minnesota Power, North Dakota's Energy and Mineral Research Center (EMRC), the Institute of Gas Technology (IGT), Combustion Engineering (CE), and the Electric Power Research Institute (EPRI).

The test program is organized into three steps: Bench-Scale Testing, Fuel Production, and Performance Testing.

Bench-Scale Testing

The bench-scale testing portion of the test program is being performed at EMRC in North Dakota and at EPRI's Oil Agglomeration Test Facility in Devon, Alberta. The bench-scale testing is expected to be completed by March 24, 1989.

The purpose of the bench-scale test program is to provide information regarding the ability of the oil-agglomeration process to agglomerate beneficiated lignite fines, a characterization of process waste water and treatment options, and an initial assessment of the expected ash-fouling performance of the beneficiated lignite at Young #2.

The bench-scale test program involves the hot-water autoclave drying of approximately ten gallons of lignite fines at EMRC. This work is being performed by the Fuels and Process Chemistry Research Institute branch of the EMRC. The processed lignite fines are being be sent to EPRI in Devon, Alberta for agglomeration testing.

Agglomeration testing is required because it is expected that oil-agglomeration of the hot-water processed lignite fines will be used in the proposed demonstration plant. The bench-scale testing will be a relatively quick go/no-go check on the ability of the process to agglomerate beneficiated lignite fines. Should there be considerable problems with the tendency of the lignite fines to agglomerate, a re-evaluation of the fines treatment in the proposed demonstration plant would be in order.

Another part of the bench-scale test program will be to evaluate the waste water produced from the autoclaving of the lignite fines. The chemical characterization of the waste water will be performed by the Combustion & Environmental Systems Research Institute (CESRI) branch of the EMRC. The chemical analysis of the waste water will allow the EMRC to offer options regarding state-of-the-art treatment for the waste water. One of the tests performed in the waste water treatment analysis will be to subject the waste-water sample to treatment by a new biochemical process under development by EPRI's Advanced Coal Liquefaction Research Facility in Wilsonville, Alabama. This process apparently is very effective at breaking down phenols, one of the primary waste constituents expected to be in the waste water. If the EPRI process is successful, further participation by EPRI in this part of the overall process may be considered.

The final part of the bench-scale test program will be performed by CESRI. This involves testing a sample of the processed lignite fines in a drop-tube furnace to evaluate the fuel's slagging and fouling potential. Although not as detailed an evaluation as will be performed by the full-scale pilot testing, the drop-tube testing will give a somewhat better than qualitative indication of the expected fouling potential of the beneficiated lignite.

Fuel Production

The fuel production portion of the test program will be performed at IGT's pilot plant in Chicago, Illinois, and at EPRI's Oil Agglomeration Test Facility in Devon, Alberta. The fuel production is expected to be completed by March 31, 1989.

The primary purpose of this step will be to produce a minimum of three tons of hot-water processed lignite in preparation for the performance testing step which follows. The processed lignite will be screened at IGT's pilot plant and split into two fractions: coarse and fine. The fine fraction will be sent to EPRI in Devon, Alberta for agglomeration. The coarse fraction will be sent to Combustion Engineering's Fire Side Test Facility in Windsor, Connecticut.

The processing of the lignite at IGT's pilot plant will be recorded by process variables, such as residence time, temperature, and pressure. This information will be reported in a test program report to Minnesota Power. The process effluent water will be saved for possible use in EPRI's Advanced Coal Liquefaction Test Facility (depending upon results in Bench-Scale Tests, above), and a chemical characterization will be made. The production of the beneficiated lignite is expected to take three weeks.

The fine fraction of the processed lignite will be sent to EPRI's Oil Agglomeration facility in Devon, Alberta. The beneficiated lignite fines will be agglomerated and sent to Combustion Engineering in Windsor, Connecticut. One of the desirable features of the oil agglomeration process

is that it separates out mineral matter that has become mixed with the fine coal particles. After agglomeration a product compositional analysis can be made and compared to raw lignite fines. This will determine to what extent the ash and sulfur content of the coal product has been reduced. This data can be used in subsequent economic and technical analyses.

Although the proportion of the total coal processed by oil agglomeration is expected to be relatively small (10%-15%), it should be noted that liberated ash tends to concentrate in the fine fraction of the coal. Thus, a disproportionately large amount of ash removal may be achieved in the oil agglomeration portion of the process.

Performance Testing

The performance testing portion of the test program will be performed at Combustion Engineering's Fire Side Test Facility in Windsor, Connecticut. The performance testing is expected to cost $250,000, and will be completed in the interval between April 2, 1989 and May 15, 1989.

The purpose of the test program is to determine the performance characteristics of the beneficiated lignite in boilers originally designed for operation on subbituminous coals. The test program will provide Minnesota Power with key information regarding the feasibility of a lignite beneficiation plant.

Upon authorization by Minnesota Power, Combustion Engineering will commence testing the beneficiated lignite received from IGT and EPRI. Combustion Engineering's first action will be to blend the agglomerated fines portion of the beneficiated lignite with the coarse fraction, thus producing the fuel product mix expected from a demonstration, or commercial-scale facility.

The test work proposed by CE addresses four major areas in furnace performance:

1. Handling and Pulverization
   a. Flow characteristics
   b. Pasting characteristics
   c. Relative mill power consumption

2. Combustion
   a. Relative flame stability
   b. Furnace gas temperature profiles
   c. Combustion Efficiency
   d. Mass and energy balances

3. Ash Deposition
   a. Effect of furnace temperature on waterwall slagging
   b. Waterwall deposit surface temperature/thermal conductance

c. Waterwall heat absorption
d. Relative soot blowing frequency
e. Effect of temperature on furnace wall blower effectiveness
f. Chemical properties of waterwall deposits
g. Ash fusibility temperatures of waterwall deposits
h. Measurement of deposit emissivity
i. Convective tube fouling characteristics
j. Relative in-situ deposit-to-tube bonding strength.

4. Emissions
   a. In-situ fly ash resistivity
   b. SO_3 concentration
   c. Fly ash particle size distribution, composition, fusibility
   d. Dust loadings
   e. Ash EP toxicity
   f. Flue gas analyses (NO_x, SO_2, CO_2, CO, O_2)
   g. Ash slurry chemistry

These tests will be performed both with beneficiated lignite and Rosebud subbituminous coal. The purpose of this is to allow CE to calibrate its performance models based on actual experience in units designed for subbituminous coals. In this manner CE can predict, with substantial confidence, the performance of the beneficiated lignite.

In addition to the Fireside Performance Testing program, CE will perform additional standard ASTM and specialty tests to assist in its evaluation of the beneficiated lignite. The ASTM analyses are:

- Moisture
- Proximate Analysis
- Ultimate Analysis
- Higher Heating Value
- Ash Composition
- Ash Fusibility Temperatures
- Forms of Sulfur
- Hardgrove Grindability Index

The Specialty Tests are:

- Coal Abrasion Index
- Quartz Content (XRD)
- Gravity Fractionation Analysis (Slagging Potential)
- Weak Acid Leaching Analysis (Fouling Potential)
- TGA (Fuel Reactivity) on DTFS Char
- Specific Surface Area (BET) on DTFS Char

The data resulting from all the above tests will allow CE to run its computational boiler performance programs (BPP). From these programs CE will be able to simulate the operation of a utility boiler on beneficiated

lignite as the firing rate is gradually increased until reaching a design or operational limit. Specific areas to be addressed during the analysis are listed below:

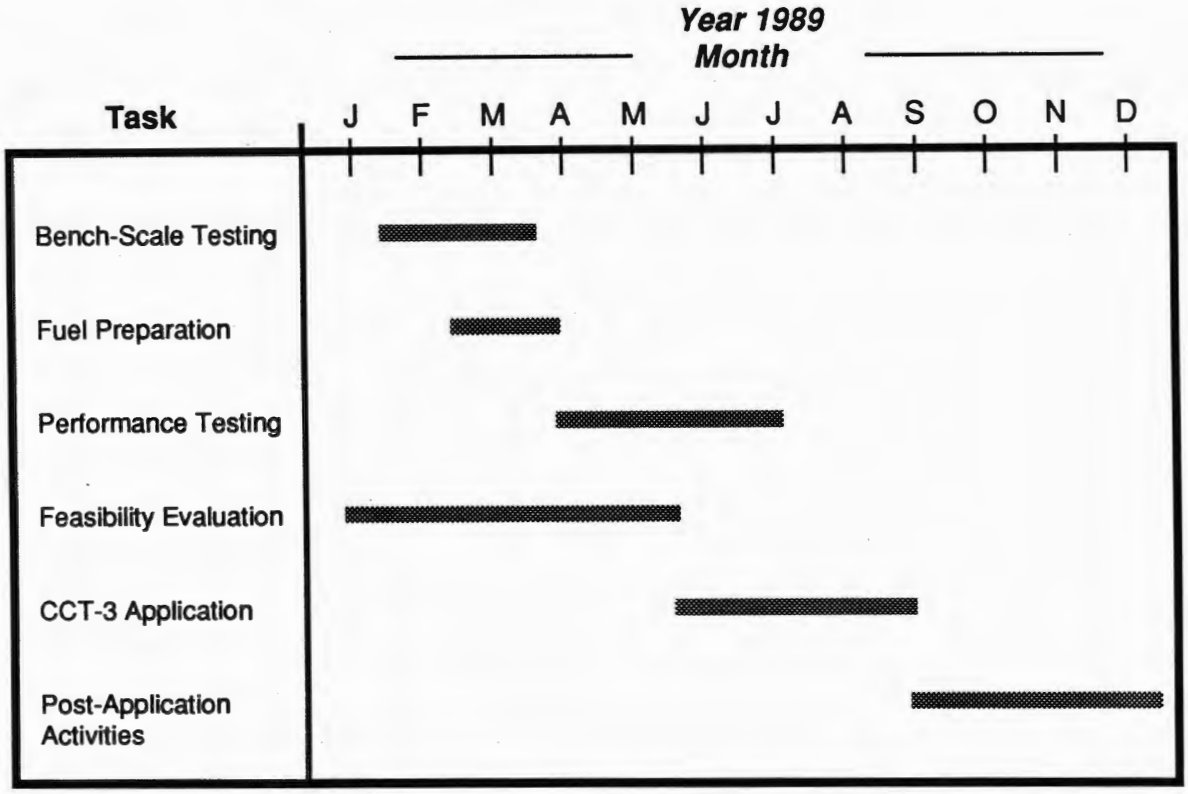
- Overall boiler efficiency
- Boiler capacity (load limitations due to heat transfer surface slagging, or fouling)
- Lower furnace performance (heat absorption rates and exit gas temperature)
- Convection pass performance (heat absorption rates and exit gas temperatures)
- Air heater performance (primary and secondary air temperature rise, air heater leakage rates, gas side efficiency)
- Pulverizer performance (power consumption, air and coal capacities)

Combustion Engineering will submit all of the above information, its conclusions, and any recommendations to Baukol-Noonan, Inc. and Minnesota Power in a final report. The final report will be expected not later than June 30, 1989.

Timetable

A timetable of the major activities by task is presented below. Following the timetable, brief descriptions of the tasks with date and deliverable summaries are given.

Lignite Beneficiation Project Timetable



Description of Tasks

Bench-Scale Testing Experimentation with North Dakota's EMRC and EPRI to determine the physical characteristics of the beneficiated lignite, and its effluent streams. The test program was initiated in January 1989, and completed on March 24, 1989. A final report will be issued by April 3, 1989. This report will include data acquired, conclusions, and any recommendations.

Fuel Preparation The Institute of Gas Technology and Electric Power Research Institute assist Minnesota Power in preparing enough fuel for the performance testing task. During this task, data regarding the performance of the beneficiation process is gathered, and process flowstreams are characterized. The fuel preparation task was initiated in February 1989, and was completed on March 31, 1989. A final report of data

acquired, conclusions, and any recommendations will be issued by May 15, 1989.

Performance Testing Combustion Engineering performs a detailed performance evaluation of the fuel (Details in the **Methods** section). The test program may be initiated on April 3, 1989. Test data should be available by May 15, 1989. The final report is expected by July 14, 1989.

Feasibility Evaluation The technical and economic feasibility of the proposed development program will be determined. The above tasks will provide key information in addition to economic modelling being performed at Minnesota Power, Baukol-Noonan, and a retained Architect & Engineer. Modelling was initiated in January, 1989 and will be completed by May 15, 1989. The decision to proceed to a CCT-3 application will be based on the results of this task.

CCT-3 Application Formally committing to the Clean Coal Technology (Phase III) application will occur after May 15, 1989. Efforts to complete the application are expected to take three months. The final application draft is expected to be ready for review by August 15, 1989.

Post-Application Activities Following the CCT-3 application,post filing activities as required by the DOE and project development will occur. These will include responding to technical inquiries by the DOE, and continued project development by Minnesota Power and Baukol-Noonan. The DOE will make public its Phase III selections on December 26, 1989.

Personnel

Brief narrative summaries of the experience and qualifications of the principal investigator and other major participants in the project are provided as required. The major project participants for the pilot plant test program are Minnesota Power, North Dakota EMRC, and Combustion Engineering.

Minnesota Power

George R. Nehls Jr. -- Principle Investigator
Research Engineer

Mr. Nehls is responsible for research activities in the area of fuels technology and minerals development. His primary duties include the investigation and evaluation of advanced coal technologies and advanced extractive metallurgical processes.

Mr. Nehls has an extensive background in industrial processes and thermochemical systems. He has participated in numerous studies determining the technical and economic feasibility of alternative energy supply systems, coal beneficiation, and advanced steelmaking.

John E. Pelerine
Supervisor Plant Engineering

Mr. Pelerine is responsible for administration and technical management of Minnesota Power Plant Engineering's Mechanical, Civil, and Chemical Engineering Group. Plant Engineering performs project and support engineering for Minnesota Power's generating facilities.

Mr. Pelerine has an extensive background in plant operations, environmental/regulatory, and construction engineering. His experience includes participation in start-up and operation of pulverized-coal utility boilers, lignite-fired cyclone boilers, and the conversion of Minnesota Power's Hibbard Steam Station to a multiple-fuel-capable co-generation facility.

Combustion Engineering

Armand A. Levasseur
Manager - Fuels Technology

Mr. Levasseur is responsible for research activities in the area of fuels technology. His primary duties include the administration and technical management of about 15 engineers and technicians involved in

experimental research in the areas of combustion, pyrolysis, fluidized bed combustion, pulverization, ash deposition and emissions.

Mr. Levasseur has developed an extensive background in the areas of fuel properties and their impact on boiler performance. He has authored more than 30 technical papers in the areas of combustion and fuel behavior presented at major scientific conferences and symposiums. He has served as program manager and/or principal investigator of numerous major research programs dealing with the development and application of new or unusual fuels. He has investigated fuel performance impacts associated with coal beneficiation, coal water fuels, additive usage, and limestone injection. Mr. Levasseur has been responsible for the design and construction of comprehensive pilot-scale test facilities as well as the development of both bench-scale and large-scale testing techniques.

Mark D. Mirolli
Consulting Engineer, Kreisinger Development Lab

Mr. Mirolli is responsible for management, test supervision and reporting of R & D programs at the Kreisinger Development Lab. Activities have included work on a Combustion Engineering sponsored tangential low NO_x burner development program, and engineering studies supporting a coal gasification demonstration program.

Mr. Mirolli has been responsible for long and short term development items supporting fluid bed boiler technology. Standards development, lab and field testing, and engineering studies are his major job functions.

Lorraine S. Miamiac
Principal Engineer, Generating Systems Development

Ms. Miamiac has developed an extensive background in research and development assessing the influence of fuel and ash properties upon boiler design and performance. During her past eight years in the industry, she has been responsible for the pilot-scale testing and evaluation of various coal and alternate fuels, including coal-oil mixtures (COM), coal-water mixtures (CWM) and coal liquefactory process bottoms. In addition, she has experience in the water-side and fire-side performance analyses of fossil steam generating systems.

Ms. Miamiac is responsible for the performance analysis of utility and industrial steam generators when firing alternate fuels. This work typically includes the interpretation and application of laboratory, pilot-scale and field test data to computer coded boiler performance prediction programs.

North Dakota Energy and Mineral Research Center

Todd A. Potas
Research Supervisor
Low-Rank Coal Beneficiation

Mr. Potas has been the Research Supervisor of the Low-Rank coal Beneficiation Group since 1987. His primary duties currently involve supervising and performing research programs involving low-rank coal cleaning and drying technologies and coal/water fuel preparation. Mr. Potas has extensive experience with the EMRC's continuous hot-water-drying pilot plant, and coal gasification analysis.

Mr. Potas' principle areas of expertise include thermal upgrading and drying of low-rank coals, physical and chemical cleaning of low-rank coals, and the preparation and rheology of coal/water fuel.

Qualifications

Baukol-Noonan, Inc. (BNI) was incorporated in the state of North Dakota in 1949. BNI is engaged in the business of surface mining and sale of North Dakota lignite coal. BNI operates the Center mine, which delivered 3.7 million tons of lignite to its customers in 1987. Historically, BNI has been one of the lowest cost producers of lignite in the state of North Dakota. BNI is a wholly owned subsidiary of Minnesota Power.

Minnesota Power (MP) is an investor owned electric utility operating generating facilities and providing electric service in northern Minnesota and northwestern Wisconsin. MP operates the coal fired Clay Boswell Steam Electric Station in Cohasset, Minnesota. Clay Boswell SES is rated at over 1,000 MW of generating capacity. In addition, MP operates the Syl Laskin SES near Aurora, MN, and the Hibbard steam station in Duluth, MN.

Budget

Baukol-Noonan, Inc. and Minnesota Power are requesting a grant of **$70,000** from the Lignite Research Council to help defray the cost of their lignite beneficiation project during 1989. The gross 1989 cost of the project is estimated to be **$670,000**.

The 1989 project budget is separated into two phases: Pilot Plant Testing, and DOE Clean Coal Technology Program (CCT) Application. At this time, only the Pilot Plant Testing phase has been estimated in detail.

Baukol-Noonan, Inc. and Minnesota Power charge at a rate of $26 per person-hour ($4,500 per person-month), including overheads.

The Pilot Plant Testing is expected to cost **$450,000** and can be organized into three steps: Bench-Scale Testing, Fuel Production, and Performance Testing. Minnesota Power has sub-contracted the execution of each step at a fixed price (excluding in-house labor):

- The Bench-Scale Testing has been sub-contracted to North Dakota's Energy & Mineral Research Center for $20,000.
- The Fuel Production has been sub-contracted to the Institute of Gas Technology for $150,000.
- The Performance Testing has been sub-contracted to Combustion Engineering for $240,000.

More detailed information regarding these contracts can be obtained from Minnesota Power and/or the sub-contractor.

In addition to the fixed price contracts, Baukol-Noonan, Inc. and Minnesota Power expect that in-house labor to administer, manage, and engineer the Pilot Plant Testing will require seven person-months of effort. This is equivalent to a cost of $30,000. A $10,000 contingency is also estimated. These costs are summarized below.

Pilot Plant Test Program Phase	**Cost ($)**
BNI, MP labor	30,000
Bench-Scale Testing	20,000
Fuel Production	150,000
Performance Testing	240,000
Travel, Misc. & Contingency	10,000
Total Gross Cost	**$450,000**

The CCT application is estimated to cost **$220,000**. This is split between a retained consultant/A&E expenditure of $160,000, and an assumed $40,000 in-house expenditure at Baukol-Noonan, Inc. and Minnesota Power (nine

person-months of effort). A contingency of $20,000 is included. These costs are summarized below:

Clean Coal Technology Phase	**Cost ($)**
BNI, MP labor	40,000
Consultant/Architect & Engineer	160,000
Travel, Misc. & Contingency	20,000
Total Gross Cost	**$220,000**

A summary of the total anticipated 1989 lignite beneficiation project cost is given below:

Lignite Beneficiation Project Cost	**Cost ($)**
Pilot Plant Test Program Phase	450,000
Clean Coal Technology Phase	220,000
Total Project Gross Cost	**$670,000**
Lignite Research Council Grant	**($70,000)**
Baukol-Noonan & Minnesota Power Net Project Cost	**$600,000**

This concludes Baukol-Noonan, Inc. and Minnesota Power's research grant application to North Dakota's Lignite Research Council.