RONALD H. BERTOCH
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BNI COAL

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April 1, 1992

Ms. Karlene Fine
Secretary to the Industrial Commission
Industrial Commission
State Capitol
Bismarck, ND 58505

Dear Karlene:

Enclosed is the application of BNI Coal and Minnesota Power for a grant from the North Dakota Lignite Research Fund. BY this application, BNI and Minnesota Power hereby commits itself to complete the project as described in the application should the Industrial Commission of North Dakota make the grant requested by the application.

The applicant certifies that it has read an understands the statutes and administrative rules governing grants from the Lignite Research Fund and agrees to all conditions and terms set forth therein. There applicant also certifies that all information contained in the application is true to the best of the applicant's knowledge, and acknowledges the right of the North Dakota Industrial Commission to modify or terminate any subsequent agreements with applicant if the Commission becomes aware of any material misrepresentation contained in this application.

Sincerely,

BNI COAL, LTD.

Ronald H. Bertoch

Ronald H. Bertoch

RHB/cfb
Enclosures

K-Fuel® Processing of North Dakota Lignite

Grant Application

for the amount of $50,000

submitted by,

BNI Coal, Ltd.
1136 West Divide Avenue
Bismarck, ND 58502
&
Minnesota Power
30 West Superior Street
Duluth, MN 55802

date of submission,
April 1, 1992

Ronald Bertoch

Project Manager,
Ronald H Bertoch

George R. Nehls jr.

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

Attach. K-3

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Project Abstract

The objective of the project BNI Coal, Ltd. and Minnesota Power are undertaking is the investigation of the potential the K-Fuel® process represents to North Dakota lignite. A two phase project is proposed. The first phase involves the preparation and analysis of test fuel using the K-Fuel® process. The second phase will involve combustion testing of the fuel product. The second phase will be undertaken only if the data from the first phase is satisfactory. If the process development work continues to be successful, it could result in expanding the lignite industry for the state of North Dakota.

The expected result of the project is the characterization of a lignite/K-Fuel® product. The characterization would include conventional analysis, including proximate and ultimate analysis, forms of sulfur, and specialized combustion testing (if the second phase is undertaken).

A total grant of **$50,000** is being requested. The estimated total gross cost of the activities is **$112,500**. The first phase is estimated to cost $43,500. The second phase is estimated to cost $69,000.

The first phase of the project is expected to take two months to complete from its initiation. The second phase, including reporting, is expected to take three months to complete.

BNI Coal, Ltd. and Minnesota Power will provide the matching funds for this funding cycle. It is also possible that the U.S. Department of Energy (DOE) will participate in Phase I of the project. The subcontractors will be Western Research Institute for Phase I, and the North Dakota EERC for Phase II.

Project Summary

The objectives of BNI Coal, Ltd. and Minnesota Power's lignite/K-Fuel® test work can be summarized as follows:

- The ultimate objective of the project would be to economically up-grade, or beneficiate, North Dakota lignite to an export quality boiler fuel. Upon successful demonstration of the technology, this would entail the construction and operation of at least one commercial-scale lignite processing plant.

- The immediate objective of the proposed project is to determine the characteristics and properties of a beneficiated lignite produced through the K-Fuel® process.

Utilization of lignite is currently limited due to its high moisture content. It also has other undesirable qualities, such as relatively high sulfur content, and, following exposure after mining, a tendency to decrepitate, causing dustiness, and spontaneous ignition. The K-Fuel® process claims to simultaneously reduce all of the above undesirable features. The end product is claimed to be a high grade boiler fuel. In order for BNI Coal and Minnesota Power to evaluate the potential of the process, testing of the process on lignite will be required.

Project Description

The project will be divided into two phases. The objective of the first phase will be to process raw lignite through the K-Fuel® pilot process reactor to determine basic product properties, such as heating value, moisture, ash, sulfur, volatile and fixed carbon contents. In addition, an ultimate analysis, ash compositional analysis, and forms of sulfur will be performed. These analyses will be performed on both raw lignite feedstock, and the fuel product. The data and conclusions of the first phase will be summarized in a report. If the product properties are within their targets (particularly the sulfur content), the project would proceed to the second phase.

The K-Fuel® pilot plant is located near Gillette Wyoming. The work will be performed under contract to Western Research Institute (WRI), which has subcontracted with Energy Brothers, Inc., the owners of the facility. The processor operates essentially as an autoclave. It is a vertical cylinder with an internal capacity of approximately one cubic foot. The peak process temperature and pressure will be approximately 540° F and 1150 psig, respectively. North Dakota lignite will be placed in the processor, and driven through a temperature/pressure excursion lasting about thirty minutes. The process uses saturated steam as the heating medium, although the walls of the processor have electrical resistance heating to limit heat loss through the processor's walls. The cost of performing the upgrading is estimated to be $40,000.

The second phase's objective would be to determine the combustion characteristics of the lignite/K-Fuel® product. This work would be performed by the North Dakota Energy and Environmental Research Center (EERC). The combustion testing would involve fuel burn-out characteristics, ash deposition behavior, and emission characterizations. The data and conclusions of the second phase testing would be summarized in a report.

The EERC combustion test program will require burning the lignite/K-Fuel® alone, and then along with a blend of western subbituminous coal. The purpose of each test will be to determine the fouling and slagging characteristics and the collectibility of each fly ash as a function of fuel type and operating conditions. Each test will be run at a furnace exit gas temperature of 2200° F and an excess air level of approximately 20%. During each test, gaseous emissions of O_2, CO_2, SO_2, and NO_x will be monitored. It was felt that no baseline combustion test utilizing the BNI lignite would be required because of previous experience firing BNI coal in EERC's combustion test facility (CTF). In addition to the two combustion tests, two flame stability tests would also be performed to determine the stability of the flame as a function of secondary air swirl at full load and under turndown conditions. Computer controlled scanning electron microscopy (CCSEM) and chemical fractionation will be performed on the lignite/K-Fuel® to determine the size and association of the inorganic species comprising the bulk of the ash-forming minerals in the fuel. The total cost of these tests is estimated at approximately $64,000: $24,000 per combustion test, $7,000 per flame stability test, and $2,000 for the CCSEM and chemical fraction analyses.

BNI Coal and Minnesota power propose to contract with WRI to perform the initial testing and analysis, and if the sulfur reduction is acceptable, proceed to the EERC combustion testing. If the sulfur reduction is not acceptable, the EERC combustion testing will not be performed.

As a result of this bi-phased approach, BNI Coal Ltd. and Minnesota Power proposes an agreement with the Lignite Research Council regarding the requested grant funding which reflects the go/no-go nature of the second phase. In particular, BNI Coal Ltd. and Minnesota Power request an initial grant of $20,000 to share the costs of the project's first phase. This will be remitted by the LRC to BNI Coal, Ltd. in full upon acceptance of a final report for the first phase. The final report for the first phase will also include a decision regarding the second phase. If the project ceases following conclusion of the first phase, no further action on the part of either BNI Coal Ltd. or the LRC will be necessary. If it is decided to proceed with the second phase, additional grant funding totaling $30,000 will be made available. The proposed payment plan will be: an initial installment of $10,000 immediately upon notification (included in the Phase I final report), an additional $10,000 upon acceptance of an intermediate status report, and a final $10,000 upon acceptance of the Phase II final report.

Both the environmental and economic impacts of the testwork on either the Gillette, Wyoming area or the Grand Forks, North Dakota areas are expected to be negligible. Regarding the ultimate technological and economic impact: if the project successfully determines that an export quality lignite can be made with the present version of the K-Fuel® process,

an expanded lignite market base could result, along with the construction of at least one commercial facility to produce the product fuel.

The project is needed to determine the ability of the revised K-Fuel® process to adequately beneficiate North Dakota lignite.

Standards for Success

The ultimate goal of this and other beneficiation work is the successful development of an economic, export quality boiler fuel. A necessary condition of this goal will be to produce a fuel product which has marketable characteristics. The standards of success for this test work are therefore interpretable in terms of the market characteristics of the fuel product. These can be defined by project task:

Phase I: initial product characterization. The tests will be considered successful if the fuel product has, compared to the raw feed stock, a permanent moisture reduction of 80% or more, a sulfur reduction of 40% or more, a retention of 95% of its total heating content, and a heating value exceeding 11,000 Btu/lb.

Phase II: combustion characterization. The tests will be considered successful if the fuel product has: fuel burn-out equal to or superior to the raw lignite, minimal ash deposition problems, and a sulfur emission approaching, or less than 1.2 lbs of sulfur dioxide per million Btu fired.

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 primarily investigating the process known as "hot-water-drying" of low rank coals since early 1986. Minnesota Power has, however, continued to follow the general development of coal beneficiation as a technology and potential industry. BNI Coal, Ltd. has provided valuable information regarding lignite characteristics and resource availability.

Mr. Ed Koppleman patented a thermochemical process in the late 1970's which has come to be known as the K-Fuel® process. The K-Fuel® process originally incorporated hot-water-drying as the first stage of a two stage process. The second stage was a mild pyrolysis of the hot-water-dried intermediate product which resulted in a further reduction of moisture content and a significant reduction of the volatile content of the coal feedstock. The extracted volatiles were combusted to provide the driving energy for the process. Following the second stage pyrolysis, the coal was to be hot extruded to create the final product: a high Btu, essentially zero moisture content, slightly carbonized fuel with essentially zero fines content. Recently, the K-Fuel® interests have redesigned their process to simplify it. The process at this time is limited to steam drying at temperatures above 450° F. The K-Fuel® interests have claimed that the simplified process produces essentially the same fuel product at a reduced cost, compared to their original process. In addition, it is claimed that the

modified K-Fuel® process removes a significant amount of sulfur from the feed stock coal: up to 40% in some cases.

BNI Coal Ltd. and Minnesota Power have determined that, for a beneficiated fuel product to be considered "export quality," it should at least approach a compliance fuel. A compliance coal has a sulfur dioxide emission of 1.2 lbs of SO_2 per million Btu, or less.

BNI Coal Ltd. and Minnesota Power's experience with hot-water-drying of North Dakota lignite has shown that minimal sulfur reduction occurs with hot-water-drying. Process modifications, in which the lignite is first physically cleaned prior to hot-water-drying have been technically successful, although the cost of grinding and cleaning appears to be unacceptably high.

As a result of these experiences and the claims of the K-Fuel® interests, it is thought worthwhile to initiate testing of North Dakota lignite with the K-Fuel® process. If substantial sulfur reduction occurs as a result of the K-Fuel® process, it may be possible to design an overall process which economically achieves the necessary up-grading of lignite for it to be marketable on a regional, or larger scale.

Qualifications

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 lignite/K-Fuel project

are: BNI Coal Ltd., Minnesota Power, Western Research Institute, Energy & Environmental Research Center, and ENSERV (a subsidiary of Heartland Fuels Corporation)

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.

BNI Coal, Ltd. (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.

Energy and Environment Research Center

Dr. Michael L. Jones has held the position of Director of the Combustion and Environmental Systems Research Institute, one of the Institutes of the School of Engineering and Mines' Energy and Environmental Research Center (EERC) at the University of North Dakota.

Prior to his current position as Director of the EERC Combustion and Environmental Systems Research Institute, Dr. Jones held positions with the Department of Energy Grand Forks Energy Technology Center, including Project Manager for Combustion Research, Chief of the Inorganic Analysis Branch, and Research Physicist.

Western Research Institute

Mr. Norman W. Merriam is a senior staff research chemical engineer at the Western Research Institute as a project manager at WRI and principal investigator for a pilot-plant study of mild gasification of coal. Mr. Merriam designed and tested the plug-flow, inclined fluidized-bed reactors

that are a key component of the patented WRI mild gasification of coal and coal drying processes. Successfully tested retorting of oil shale and combustion of spent shale and tar sands using the inclined fluidized-bed reactors.

Value to North Dakota

The project will have direct impact on the North Dakota lignite industry. If the project succeeds in adequately upgrading North Dakota lignite, an increase in the marketability of North Dakota lignite would result. At this time, projections regarding the magnitude of increased industry, such as lignite tonnages, workforce requirements, etc., cannot be estimated.

Management

Overall management of the project will be by BNI Coal Ltd. This will include responsibility for assuring that the project tasks are satisfactorily completed on time, within budget and are adequately reported. Technical assistance will be by Minnesota Power at BNI Coal's request.

The first phase of the project (production of fuel and initial assessment) will be under the management of Western Research Institute. This will include responsibility for performing the lignite beneficiation and tests on the raw and product lignite. The WRI will additionally be responsible for reporting the results in a timely and accurate manner, and shipping the product fuel to the North Dakota EERC.

The second phase of the project (combustion testing) will be under the management of the North Dakota EERC. This will include responsibility for receipt and care of the fuel product, and the combustion tests and their analyses. The EERC will additionally be responsible for summarizing the results in a timely and accurate manner.

Timetable

The project, both phases included, would be expected to take five months from its starting date to completion of the final report. The first phase, including completion of the first phase final report is expected to take two months. The second phase is expected to take three months.

Budget

BNI Coal, Ltd. and Minnesota Power are requesting a grant of **$50,000** from the Lignite Research Council. The gross cost of all the tasks described in this application is estimated to be **$112,500.**

The project is divided into two phases. The first phase, production of the fuel is estimated to have a gross cost of $43,500, including BNI Coal's administrative costs. The second phase, combustion testing of the fuel, is estimated to have a gross cost of $69,000, including combined administrative costs to BNI Coal, Ltd. and Minnesota Power. BNI Coal, Ltd. and Minnesota Power charge at a rate of $29 per person-hour ($5,000 per person-month), including overheads. Detailed information regarding

subcontractors can be obtained from Minnesota Power and/or the specific sub-contractor.

Western Research Institute has estimated the cost of upgrading the lignite and performing the initial analyses as a flat fee of $40,000. Details concerning the wages, rates, indirect costs, and direct costs can be obtained from WRI.

The North Dakota Energy and Environmental Research Center has estimated the cost of performing the combustion testing on a per task basis: $24,000 per combustion test, $7,000 per flame stability test, and $2,000 for analyses. Details concerning the wages, rates, indirect costs, and direct costs can be obtained from EERC.

K-Fuel® Process Estimate	Cost ($)
Phase I Fuel Preparation	
Western Research Institute	40,000
BNI, MP labor	3,500
Phase I Gross Cost	**$43,500**
Phase II Fuel Combustion	
North Dakota EERC	64,000
BNI, MP labor	5,000
Phase II Gross Cost	**$69.00**
Total Project Gross Cost	**$112,500**

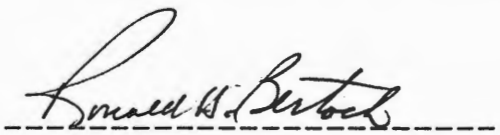
Lignite Research Council Grant (Ph I)	**($20,000)**
Lignite Research Council Grant (Ph II)	**($30,000)**
BNI Coal, Ltd. & Minnesota Power	
Net Project Cost	**$62,500**

Matching Funds

Western Research Institute has an opportunity to apply and receive an $18,000 grant from the Department of Energy. In the event that this occurs, BNI Coal Ltd, and Minnesota Power will refund fifty percent (50%) of any credits received from WRI for beneficiation of lignite by the K-Fuel® process.

Affidavit

I, the undersigned Ronald H. Bertoch of BNI Coal, Ltd. do hereby certify that BNI Coal, Ltd. does not have an outstanding tax liability owed to the State of North Dakota or any of its political subdivisions.



Ronald H. Bertoch
Executive Vice President