LRC-II-12

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September 28, 1988

Mr. Timothy Kingstad
Executive Committee
Lignite Research Council
North Dakota State Land Department
State Capitol
Bismarck, ND 58505

Dear Tim:

In the last round of proposal review by the Lignite Research Council, the UNDSEM Foundation submitted a two-phase proposal for the Council's participation in the UND-NDSU Technology Transfer Office in Europe. Phase One was funded to partially cover the travel costs of a North Dakota energy delegation to the region around Essen, West Germany. The original Phase Two proposal called for $20,000 of program support to allow the TTO to focus a portion of its efforts toward the lignite industry.

Enclosed is an addendum to the original proposal for Phase Two for consideration in this round.

Phase Two has been modified based on observations from the North Dakota Energy Delegation's visit to West Germany to include two parts. Part I will investigate the possibility of using North Dakota lignite char in a manner similar to that in which brown coal char is currently used in Europe. A $20,000 evaluation program is proposed. Part II is for program support of the TTO similar to the initial request but at a reduced level of $10,000.

We look forward to a favorable review of the project.

Sincerely,

for DVM

Don Mathsen, P.E.
Executive Director
UNDSEM Foundation

DVM/slc

c: Alan Fletcher
Gerald Groenewold
Everett Sondreal

# DEVELOPMENT OF EUROPEAN MARKETS AND SOURCES FOR LIGNITE TECHNOLOGY

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# DEVELOPMENT OF EUROPEAN MARKETS AND SOURCES FOR LIGNITE TECHNOLOGY


## SUMMARY

Phase One of the proposal entitled, "Development of European Markets and Sources for Lignite Technology" was funded by the North Dakota Lignite Research Council in April 1988. Phase One funded travel costs for a North Dakota Energy Delegation to the coal region around Essen, West Germany. The trip was conducted May 14-21, 1988. The trip report is included as Appendix A.

The trip included a visit to the Garath Power Plant operated by Stadtwerke Dusseldorf AG. This facility employs a lignite (brown coal) "coke" filter cake tower through which all gaseous emissions pass downstream from an electrostatic precipitator and a quasi-dry spraying system.

The lignite "coke" absorbs SO2 from the flue gas, enables reaction with oxygen and water vapor to form sulfuric acid, and allows partial retention through reaction with the calcium in the ash. NOx removal is accomplished by injection of ammonia resulting in conversion to nitrogen and water. NO2 is reduced to free nitrogen and carbon dioxide by the coke. In addition, the "coke" has been shown to be particularly effective in removing heavy metals (e.g., mercury), halogen compounds (e.g., HCl), ammonia, and many organic compounds (e.g., dioxins). Thus, the use of lignite "coke" is particularly well-suited as an emission control technology for refuse-fired power plants.

Part I of this proposal requests funds to provide background analytical evaluations of the coke from the Garath Plant in both the "free" and "loaded" states. Determination of the chemical and physical properties of these samples will serve as reference information to determine if a material with similar properties can be derived from North Dakota lignite.

A positive chemical correlation would lead to a preliminary economic analysis of North Dakota lignite-derived material as an environmental control technology for regional refuse fired power plants under a future contract.

Part II of this proposal requests funds to allow the UND-NDSU Technology Transfer Office in Europe to direct a portion of its efforts to establish and follow through contacts in Europe which represent technologies of interest to the North Dakota lignite industry and research communities. The project of Part I is an example of the type of technology transfer which the TTO desires to initiate and investigate in the area of lignite development and utilization.

## Part I - Evaluation of Formed Coke Products

### OBJECTIVES

The project has two objectives:

* To investigate the effectiveness of an environmental control technology for use with refuse derived fuel (RDF) combustion systems.

* To investigate a new market for North Dakota lignite.

### BACKGROUND

The technology has been described in a paper entitled, "Use of Lignite Coke for Reduction of NOX after Flue Gas Desulphurization" which was presented at the Fourteenth Biennial Lignite Symposium in Dallas, Texas (May 1987). Discussions with the authors of the paper and a subsequent visit to the Stadtwerke Dusseldorf AG installation of this technology at the Garath Power Plant in Dusseldorf have followed.

The German process involves production of a "fine coke" using a rotary hearth furnace technique. This is a formed coke product from lignite char. In Germany, this fine coke can be produced from Rheinische brown coal at ten percent the cost of activated coke from the higher rank coking coals. This formed coke product is packaged in filter beds through which stack gases pass.

The growth in the refuse-derived-fuel (RDF) power industry throughout the country opens up new markets for a gas clean-up system which is capable of removing heavy metals, chlorinated hydrocarbons, and other organics, as well as SOx and NOx emissions. The apparently successful demonstration of this technology in Germany in such applications may pave the way for adaptation in the Unites States.

The development of a similar product derived from North Dakota lignite may lead to adoption of this environmental control technology for RDF plants in the United States based on a North Dakota product.

Considerable work has been performed at the EMRC and other locations over the past thirty years investigating lignite char production and properties. A current project at the EMRC on the development of a mild gasification technique is studying various uses for the char which results from this process. This proposed study will be conducted in parallel and will complement the mild gasification program.

## GOALS

The project will address two goals as preliminary steps to determine the technical viability of developing a formed coke product from North Dakota lignite.

* To characterize the chemical and physical properties of the material currently used in German stack gas clean-up systems.

* To assess whether a similar material derived from North Dakota lignite with absorptivity and structural properties similar to the German material could be produced.

## METHODS

The following steps/tests will be performed.

1. Samples of the formed coke product used in West Germany will be procured for analysis at the EMRC. Samples of the unexposed material and samples of the material loaded with absorbed gases, metals, and compounds at the maximum level to which the coke is exposed in commercial operation will be obtained.

2. Both the fresh and loaded samples will be characterized for absorbed metals, organics, and compounds associated with SOx and NOx removal (i.e., $H_2SO_4$ and $CaSO_4$). The analysis will include scanning electron microscopic mapping of metals, metals analyses, extraction of organics, and combined GC-MS (gas chromatography and mass spectrometry).

3. Bulk properties including proximate and ultimate analysis of the coke product will be conducted.

4. The results of the evaluation will include a recommendation relative to whether or not further development of a similar product from North Dakota lignite should proceed. If so, an outline of subsequent steps will be provided.

## TIMETABLE

| | |
|---|---|
| Sample Procurement | October, 1988 |
| All Analyses | November-December, 1988 |
| Final Report | January, 1989 |

## PERSONNEL AND QUALIFICATIONS OF APPLICANT

The principal participants in the program will be Dr. H. Peter Hombach, Director of the UND-NDSU Technology Transfer Office in Europe and Dr. Curtis Knudson, Senior Research Associate at EMRC. Other participants who will supervise the laboratory analyses include Dr. Steven Benson (surface analyses), and Mr. David Hassett (metals and other inorganic analyses). Vitae abstracts are attached.

The project will be coordinated with the mild gasification program ongoing at the EMRC.

## BUDGET

The work will be performed at a total cost of $20,000 distributed as follows:

| | |
|---|---|
| Contact Work and Sample Procurement in Germany | $ 2,000 |
| EMRC Analytical Work | $18,000 |
| Total Project Request | $20,000 |

The analytical work will be performed under a subcontract to the UNDEMRC.

## Part II - Program Edict Support for TTO

As per the original submission of this proposal, funds are requested for the program edict support of the UND-NDSU TTO in Europe . These funds will be used to cover the non-salary operating expenses of the office in identifying research, development, and commercial technologies which represent new uses for North Dakota lignite.

This proposal requests $10,000 for the program edict suport of the TTO for a period of one year following approval of this request.

As this proposal represents Phase Two of the original proposal entitled, "Development of European Markets and Sources for Lignite Technology," the matching funds portion of this request is maintained as outlined in the original proposal of April 1. The activities of the Technology Transfer Office in Europe have been supported by cash contributions of the University of North Dakota ($20,000), the Grand Forks Region Economic Development Corporation ($5,000), and Northern States Power Company ($10,000). These funds cover the operational costs of the Office in Europe which have led to the establishment of the West German contacts associated with this project.