TECHNICAL REVIEWERS' COMMENTS

LRC-LXXIV(74)-A:
"Optimization Tools to Manage Coal Properties and Plant Operations"
Submitted by: Microbeam Technologies, Inc.;
Request for: $299,972; Total Project Costs: $699,972;
Principal Investigator: Steven A. Benson, Ph.D.
Project Duration: Two Years.

1. OBJECTIVES

The objectives or goals of the proposed project with respect to clarity and consistency with Industrial Commission/Lignite Research Council goals are: 1 - very unclear; 2 - unclear; 3 - clear; 4 - very clear; or 5 - exceptionally clear.

Reviewer 12-10 (Rating: 4)

Achieving the objectives of this project could improve the operation, performance and power generation cost for lignite fired cyclone boilers, which are required to meet lower emissions levels. This would help preserve ND jobs and lignite production associated with existing ND cyclone power plants. The project will produce a database of lignite properties that could also support other existing technologies as well as future technologies such as slagging gasifiers and slagging pressurized oxy combustors.

Reviewer 12-11 (Rating: 5)

Note: Reviewer 12-11 did not provide comments.

Reviewer 12-12 (Rating: 5)

The goals of the proposed project are clearly defined and consistent with NDIC/LRC goals and objectives. The goal of this project is to develop improved tools to manage lignite properties and plant operations based on measureable lignite properties that can be used to improve low-NOx cycle operation. Five separate objectives are identified in order to achieve project goals.

Reviewer 12-13 (Rating: 4)

The goal of this project is to develop improved tools to specifically manage lignite properties, plant operations and managers and identify needed updates to include changes in system design and operation parameters.

2. ACHIEVABILITY

With the approach suggested and time and budget available, the objectives are: 1 - not achievable; 2 - possibly achievable; 3 - likely achievable; 4 - most likely achievable; or 5 - certainly achievable.

Reviewer 12-10 (Rating: 4)

The budget appears adequate for the sampling and measurements proposed for two - one week test periods and the subsequent analysis and information transfer. Capability of developing of highly reliable of new lignite properties indices is very good, but not clearly defined by the description of scope of work. Understanding and consideration of the impacts of operating conditions during the tests are essential.

Reviewer 12-11 (Rating: 4)

Note: Reviewer 12-11 did not provide comments.

Reviewer 12-12 (Rating: 4)

The goals of this project are most likely achievable given the suggested time and budget.

Reviewer 12-13 (Rating: 3)

The objective is to identify and develop improved tools to manage and upgrade numerous systems, combustion systems, reduce environmental emissions, improve mechanical and cyclone substoichiometric combustion systems' air to reduce NOx emissions and particulate slagging, fouling combustion emissions approach suggested, and time and budget available.

3. **METHODOLOGY**

The quality of the methodology displayed in the proposal is: 1 - well below average; 2 - below average; 3 - average; 4 - above average; or 5 - well above average.

Reviewer 12-10 (Rating: 4)

The approach utilizes advanced analytical methods that should allow more accurate characterization of key lignite characteristic and more reliable correlations (indices/tools). The methodology builds from existing knowledge successfully applied for previous unstaged cyclone operation. Additional measurements and calculations to better define unit conditions (such gas temperatures, wall temperatures, heat flux to wall/deposits, environment at the wall/ gas composition, etc., etc.) that also have a strong impact slag behavior, furnace and convection pass deposition and fly ash properties would be helpful to isolate the impacts due to changes in lignite properties. The ability to systematically change and control conditions as well as varied and control lignite properties is also not fully described in the scope of work, but important for development of reliable correlations.

Reviewer 12-11 (Rating: 4)

Note: Reviewer 12-11 did not provide comments.

Reviewer 12-12 (Rating: 4)

The quality of the methodology displayed in the proposal is above average.

Reviewer 12-13 (Rating: 4)

Identify, establish, evaluate existing and current projected future properties to determine impacts of NOx on slag, ash behavior, improve and develop new tools for plant, mining personnel to utilize and validating through testing at plant sites.

4. CONTRIBUTION

The scientific and/or technical contribution of the proposed work to specifically address Industrial Commission/LRC goals will likely be: 1 - extremely small; 2 - small; 3 - significant; 4 - very significant; or 5 - extremely significant.

Reviewer 12-10 (Rating: 3)

This work should provide an important contribution to lignite-fired power plants in optimizing plant operations and cost for control of NOx emission control.

Reviewer 12-11 (Rating: 3)

My comment would be that much of the data and parameters would tend to specifically benefit one mine and plant with somewhat limited benefit across the rest of the fleet.

Reviewer 12-12 (Rating: 3)

The technical contribution of the proposed work for the NDIC/LRC & ND lignite industry is significant if the tools are applicable only to the MRY Station. If the tools are developed applicable and useful for the rest of the ND cyclone burners, then the proposed work could be very significant for the NDIC/LRC.

Reviewer 12-13 (Rating: 5)

Cyclone-fired plants are addressing substoichiometric combustion producing slag flow behavior, freezing, wall salaging, conventive fouling, particulate emissions. Current tools need updated tools to manage mechanical issues, including operational modifications.

5. AWARENESS

The principal investigator's awareness of current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 - very limited; 2 - limited; 3 - adequate; 4 - better than average; or 5 - exceptional.

Reviewer 12-10 (Rating: 5)

Extensive experience and knowledge in all of the areas proposed as well as world class expertise in associated areas that provide additional insight and more effective performance of the project.

Reviewer 12-11 (Rating: 5)

I would say that much of the research will not be that new and different… only to the extent that it is being done with the new low NOx operation and the associated issues that come with that.

Reviewer 12-12 (Rating: 5)

The PI's awareness of current research activity is well documented in the technical discussion and references cited on pages 15 and 16 of the proposal.

Reviewer 12-13 (Rating: 5)

The principal investigator's awareness of current research activity and published literature, as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal, is exceptional.

6. **BACKGROUND**

The background of the investigator(s) as related to the proposed work is: 1 - very limited; 2 - limited; 3 - adequate; 4 - better than average; or 5 - exceptional.

Reviewer 12-10 (Rating: 5)

Extensive experience and knowledge in all of the areas proposed as well as world class expertise in associated areas that provide additional insight and more effective performance of the project.

Reviewer 12-11 (Rating: 5)

Note: Reviewer 12-11 did not provide comments.

Reviewer 12-12 (Rating: 5)

The background of the PI as related to the proposed work is exceptional. The PI is recognized as an authority in this area.

Reviewer 12-13 (Rating: 5)

Microbeam Technologies Inc. (MTI) provides advanced analysis tools and technologies to minimize the impacts of inorganic components in solid fuels on power system performance since 1992, providing support to 1,350 commercial projects providing advanced analysis of coal, ceramics, metals and other materials for power industry and other companies.

7. **PROJECT MANAGEMENT**

The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the investigators and subcontractors, if any is: 1 - very inadequate; 2 - inadequate; 3 - adequate; 4 very good; or 5 - exceptionally good.

Reviewer 12-10 (Rating: 4)

Project organization consistent with scope and participant coordination appears good. The Project Manager has overall responsibilities for coordination, testing and development efforts as also has direct authority over key resources executing the work as President of Microbeam, Technologies, and Inc.

Reviewer 12-11 (Rating: 4)

Note: Reviewer 12-11 did not provide comments.

Reviewer 12-12 (Rating: 5)

The project management plan is exceptionally good. The PIs have tied the proposed goals-objectives-tasks into a complete Statement of Work (SOW). The SOW includes milestone chart and communication plans.

Reviewer 12-13 (Rating: 4)

The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the investigators and subcontractors, if any, is likely achievable.

8. **EQUIPMENT PURCHASE**

The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)

Reviewer 12-10 (Rating: 5)

Minimal purchase of materials.

Reviewer 12-11 (Rating: 3)

Note: Reviewer 12-11 did not provide comments.

Reviewer 12-12 (Rating: 5)

NOTE: Reviewer 12-12 did not provide comments.

Reviewer 12-13 (Rating: 4)

The proposers have facilities and available equipment, two research engineers to conduct activities: one day set-up, three days of testing, one day for tear-down.

9. **FACILITIES**

The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.

Reviewer 12-10 (Rating: 4)

State-of–the–art equipment to be utilized.

Reviewer 12-11 (Rating: 5)

Both should be extremely good and well suited for the project.

Reviewer 12-12 (Rating: 5)

The facilities at UND, MTI and MRY are exceptionally good for the proposed work.

Reviewer 12-13 (Rating: 5)

The proposers have facilities and available equipment to support research activities.

10. **BUDGET**

The proposed budget "value" [1] relative to the outlined work and the financial commitment from other sources [2] is of: 1 - very low value; 2 - low value; 3 - average value; 4 - high value; or 5 very high value.

Reviewer 12-10 (Rating: 3)

The specific number of test conditions, measurements, samples collected and samples analyzed is not clearly defined in scope of work nor are necessary plant preparations and modifications. Therefore, estimated cost are within reason, but difficult to assess. Most of financial commitment is in the form of non- NDIC sources are in-kind.

[1] "Value" – The value of the projected work and technical outcome for the budgeted amount of the project, based on your estimate of what the work might cost in research settings with which you are familiar.

[2] Financial commitment from other sources – A minimum of 50% of the total project must come from other than Industrial Commission sources to meet the program guidelines. Support greater than 50% from Industrial Commission sources should be evaluated as favorable to the application.

Reviewer 12-11 (Rating: 4)

I would say that there should be good value for the investment. My only comment would be that more "buy in" from the involved entities would be considered.

Reviewer 12-12 (Rating: 4)

The proposed budget is of high value. Cash and in-kind services are provided. More cash and participation by other cyclone furnace boilers would improve the value of the proposed work.

Reviewer 12-13 (Rating: 4)

The total project cost is $699,972. Cost share of $100,000 is provided from Minnkota, BNI, and CCS. Minnkota and BNI will each provide $40,00. CCS will provide $20,000. In-kind costs from Minnkota, BNI and CCS will also be provided. The overall project is anticipated to take two years.

OVERALL COMMENTS AND RECOMMENDATION:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer 12-10 (Rating: FUND)

The proposed project appears to be a sound technical effort that will help to improve operations, performance and emission control costs at Minnkota's MRY power plant and potentially other plants utilizing lignite-fired slagging combustors. However, the existing and future market of lignite-fired cyclone power plants is limited and must be considered against the merits of other potential candidate projects and available funding.

The number of test conditions, ability to control conditions and the time duration at each operating conditions should be clarified and review to ensure reliable data collection. Manner in test conditions impacting performance are defined and considered in the overall assessment should also be clarified. The directly applicable experience, knowledge and expertise of the Project Manager and Staff should be instrumental in efficiently execution of this work and successful achieving the proposed objectives.

Reviewer 12-11 (Rating: FUNDING MAY BE CONSIDERED)

Note: Reviewer 12-11 did not provide comments.

Reviewer 12-12 (Rating: FUND)

General comments: **FUND**

The merits of the proposed project include:

- The proposal preparation is excellent.
- The proposed work is well documented.
- The technology background is well documented.
- The background of the PIs is outstanding.

The weakness of the proposed project includes:

- The technology is not new.
- The work has been studied numerous times previously.
- It is not shown that the proposed work is beneficial beyond the BNI/MRY application.

In spite of the project weaknesses, this project is of sufficient potential value, that the project is recommended for funding.

Reviewer 12-13 (Rating: FUND)

A major challenge facing ND lignite-fired utilities is managing highly variable lignite properties. This project will develop data and tools to identify cost-effective measures to decrease NOx emissions, slag freezing, ash deposition and particulate collection, and managing problems of a unique coal (lignite). Maintaining plant operations will be a continuing challenge to ND power plants.