

TECHNICAL REVIEWERS' COMMENTS
LRC-LXVII(67) -B

“Advanced Power Systems Initiative: Lignite Feasibility Study”

Submitted by: University of North Dakota Department of Chemical Engineering

Request for: \$400,000; Total Project Costs: \$400,000

Project Manager: Steven A. Benson, Ph.D.;

Principal Investigators: Michael A. Mann, Ph.D. and Srivats Srinivasachar;

Project Duration: 12 Months.

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 09-7 (Rating: 3)

The objective would identify a clean coal technology to replace an older UND existing plant (produces district steam heating) currently using subbituminous coal. The project team proposes to evaluate a range of advanced clean coal technologies (producing both steam and power) that would specifically address ND lignite characteristics. A clean coal plant will provide increased efficiency and reduce air pollutants. An additional goal would provide educational opportunity that would provide future energy related skills. Overall, the proposed project meets NDIC goals.

Reviewer 09-8 (Rating: 4)

The project team is quite correct in stating that North Dakota lignite is facing major challenges associated with its composition and that there is a need for developing/using high efficiency systems to reduce emissions, specifically carbon emissions as these are becoming increasingly important. Assessing various options, in both the study phase and ultimately through testing at the facility, is important to the NDIC/LRC and is consistent with their goals. A secondary objective, educating/training future energy experts, is beneficial to NDIC/LRC as well.

Reviewer 09-9 (Rating: 3)

This project will investigate the technology options for and preliminary cost of a relatively small lignite power plant to replace aging steam boilers at UND. The average coal consumption for steam production is about 150 tons/day and the average electrical load is about 8 MW. The desire to use lignite as a fuel will result in lower reliability than the subbituminous coal that is currently used. The design, if economically competitive could be utilized in other similar sized units with access to North Dakota lignite. The small scale of this power plant will have little impact on the demand for North Dakota lignite

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 09-7 (Rating: 3)

The proposed schedule is of 12 months is achievable. Funding level is adequate.

Reviewer 09-8 (Rating: 4)

From past experience, the objectives are most likely achievable with the budget available and time frame proposed.

Reviewer 09-9 (Rating: 4)

The budget seems high for a preliminary design and estimates. A number of the technologies proposed for investigation are probably too expensive to utilize at the relatively small scale of this project. An early screening study should investigate whether several of these technologies have any significant potential for competitive electricity production at this scale.

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 09-7 (Rating: 3)

The proposed effort identifies a broad range of issues related to ND lignite that will be identified and applied to the appropriate clean coal technologies. A significant subcontractor participant (Envergex, LLC. President, will provide significant support and contributions to the Project Team.)

Reviewer 09-8 (Rating: 3)

The methodology appears to be well thought out. I would have preferred to see a little more detail on some of the tasks; however, the key items are listed.

Reviewer 09-9 (Rating: 3)

The proposed methodology is routine and not surprisingly academic in view of the wide range of technologies proposed for study. This approach may be important to enhance the learning experience of students. However, at its core, this project is an assessment of the best approach to replace several current subbituminous coal boilers with a new lignite fired boiler that will generate sufficient steam to meet UND requirements and also provide sufficient, reliable electricity to meet UND requirements

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 09-7 (Rating: 4)

Both the technical and corresponding scientific contribution will be very significant. Although the project is focused on replacing an aging steam boiler at the University of ND, identifying a clean coal power plant that is suitable for the many issues of ND lignite would be of benefit to the entire industry, i.e., reduce or eliminate the need for higher rank coal such as subbituminous.

Reviewer 09-8 (Rating: 3)

This project is important in ensuring lignite's continued role as a fuel source in North Dakota's institutional and industrial sector. UND is currently using subbituminous coal from Montana and, it is my understanding, there are other industrial facilities using out-of-state coal as well.

This project has the potential to set a precedent for high-efficiency, ultra-modern boiler systems for institutional and industrial facilities to compliment the utility sector use of lignite.

Reviewer 09-9 (Rating: 2)

If the design effort were successful, that design might be used by other entities within the state of North Dakota with access to economical delivery of lignite.

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 09-7 (Rating: 5)

The project team are former employees of the Energy and Environmental Research Center and were leaders in addressing lignite combustion and gasification issues. The team have produced numerous publications (including peer reviewed articles).

Reviewer 09-8 (Rating: 5)

The principal investigator and his team are very aware of the current industry and research activities.

Reviewer 09-9 (Rating: 3)

The PI from Envergen has extensive experience in the power industry.

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 09-7 (Rating: 5)

As noted in # 5 above, the Project Team were significantly responsible for the current data base for generating and understanding lignite issues.

Reviewer 09-8 (Rating: 5)

The expertise of the research team is very good.

Reviewer 09-9 (Rating: 3)

The experience of the UND EERC staff and the outside consultant are complementary.

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 09-7 (Rating: 3)

The management plan has identified specific responsibilities for each Team member that includes an Advisory Team that includes the NDIC, a UND steam plant engineer, the lignite Technology Working Group, Industry developers/vendors and the NETL.

Reviewer 09-8 (Rating: 4)

The management plan and schedule are reasonable. There is not a financial plan, per se, but the costs appear reasonable for the level of effort to be expended.

Reviewer 09-9 (Rating: 3)

There is a relatively short project. The key decisions will be whether the educational component of the project should be dropped and the selection of the A & E firm.

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 09-7 (Rating: 5)

No equipment is required.

Reviewer 09-8 (Rating: 5)

No equipment to be purchased.

Reviewer 09-9 (Rating: 5)

No equipment is to be purchased.

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 09-7 (Rating: 3)

The project is a feasibility study.

Reviewer 09-8 (Rating: 5)

No applicable. This is a “paper study”.

Reviewer 09-9 (Rating: 3)

No facilities and equipment are required for the proposed research and nothing will be purchased.

10. **BUDGET**

The proposed budget "value"¹ relative to the outlined work and the financial commitment from other sources² is of: 1 - very low value; 2 - low value; 3 - average value; 4 - high value; or 5 very high value.

Reviewer 09-7 (Rating: 3)

Reviewer 09-7 provided no comments.

Reviewer 09-8 (Rating: 4)

The budget value for the proposed work is high. The budget is reasonable for the deliverables proposed. No cost share is necessary for this proposal; therefore, the footnote is not applicable.

Reviewer 09-9 (Rating: 1)

No cost-sharing is included in this proposal. As a result it does not meet the usual criteria of eligibility for Lignite Research Council funding.

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 09-7 (Rating: FUND)

The proposed study will address clean coal technology that can be adapted to ND lignite. A driver for the information is to replace an aging subbituminous boiler producing district heat for Univ. of ND.

The feasibility study will identify clean coal technologies that may be appropriate for ND lignite. The new plant technology would be produce steam for district heating and electricity for the overall and complete University needs.

Reviewer 09-8 (Rating: FUND)

I recommend that the project be funded. As previously discussed, this project has important implications to North Dakota and the continued use of lignite both at the institutional/industrial and utility scale. It is important to the latter sector because of the potential for this facility to have research and development capabilities that are not limited to the industrial sector. The ability to integrate this state-of-the-art facility with education and training of future energy specialists is also worth noting.

IV-B-2-5

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 09-9 (Rating: FUNDING MAY BE CONSIDERED)

The project will deliver a preliminary design and cost estimate for a lignite fired power system to supply both heat and electricity to UND. There is no mention in the proposal concerning the Cost of Electricity goal for this project relative to grid delivered electricity. It was noted in the proposal that high reliability for on-campus power supply was one of the requirements for this project. It is not clear that high reliability can be assured if the boiler is to be used as a test bed for experimental work to support the education of UND students in energy technology.

This project could provide some level of training in energy technology for UND students, but having a dual objective project will undoubtedly raise the required capital investment, thus increasing the cost of the electricity and steam products and compromising the reliability of the electricity and steam supply.

The relatively small scale of the new boiler relative to large grid connected power plants may also result in high relative investment costs, but standard T&D charges may be avoided to offset the increased investment.

The potential for a small gasification plant of sophisticated boiler with significant back-end effluent cleanup requirements will result in a costly design for those options. An early screening study to eliminate obviously infeasible options should be done as the first step relative to technology selection.

The majority of the funds requested \$226,848 out of \$400,000 is for subcontracts. It was noted in the proposal that \$125,000 will be allocated to the work of the outside A&E firm leaving about \$275,000 to support the efforts of Envergen. By reducing the number of options to be studied some savings may be possible.

This project needs an early decision on whether a single dual purpose plant, supplying both steam and power, as well as student training is affordable and realistic. A single purpose project will have a much higher probability of success.