TECHNICAL REVIEWERS' COMMENTS

LRC-LXIX(69)-A: "Evaluation of Novel Technologies for CO_2 Capture"
Submitted by: Energy & Environmental Research Center
Request for: $50,000; Total Project Costs: $1,935,156
Project Manager: Brandon M. Pavlish
Project Duration: 16 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 10-1 (Rating: 4)

The overall objective is to evaluate technologies that have the potential to dramatically reduce the costs of CO_2 capture. The technology selected for evaluation is the NeuStream^{TM}-C technology. The proposal lists several program objectives and tasks specific for the proposed work. These objectives are specific and are consistent with the NDIC/LRC goals.

Reviewer 10-2 (Rating: 4)

The overall objectives of the proposed research is consistent with NDIC/LRC goals. Carbon management from lignite-fired power plants will likely be a critical issue with regulations limiting CO_2 emissions on the horizon. Lignite's role as a major fuel source for the state's power generation industry, and hence an integral part of North Dakota's economy, will be dependent upon CO_2 capture and storage technologies.

Reviewer 10-3 (Rating: 5)

The objectives of the proposed effort are very clear and consistent with the NDIC/LRC goals.

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 10-1 (Rating: 4)

The objective specific for the NeuStream^{TM}-C system are most likely achievable with the suggested time and budget request

Reviewer 10-2 (Rating: 4)

The specific deliverables of the proposed project – construction, installation, testing, and economic evaluation of the capture system – is most likely achievable with the budget and timeline proposed.

Reviewer 10-3 (Rating: 4)

The structure of the project is very straight forward. The approach is systematic and will most likely be able to achieve the goals of the program. The testing conducted is short term and will likely not provide information on the longer term impacts of the flue gas characteristics on the performance of the CO2 separation technology.

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 10-1 (Rating: 5)

The quality of the methodology displayed in the proposal is well above average. The proposer links the objectives to specific tasks and develops a reasonable statement of work. The methodology is developed with care and attention required for adequate project management and program control.

Reviewer 10-2 (Rating: 2)

Overall the methodology is lacking in details. There appeared to be more discussion on background and a parallel program than the testing proposed with this project. I would expect more details on the testing such as a test matrix and schedule for a $2 million dollar project. What constitutes verification testing? Baseline testing? Optimization testing? I would also expect testing with MEA, for which there is a wealth of CO_2 capture data available, to be part of the baseline testing for comparison purposes and not an afterthought if the budget permits. More detail on the system itself was found in the appendix, which contained the proposal from the subcontractor. The subcontractor described the system nicely but some of these details should have been in the main proposal because the reviewer did not have any details on the system until reading the appendix.

Reviewer 10-3 (Rating: 3)

The methodology appears good, however, the type of coal used in the testing was not identified. The type of coal will have an impact on the flue gas characteristics and on the ability to clean the gases prior to testing the NSG scrubber.

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 10-1 (Rating: 4)

The scientific and technical contribution of the proposed work could be very significant for the NDIC/LRC goals and the ND lignite industry. If the NeuStream system meets the performance goals set forth in Appendix B, the contribution could significantly reduce the burdensome costs imposed by CO_2 capture.

Reviewer 10-2 (Rating: 3)

The results from this research have the potential to help sustain the use of lignite in North Dakota, which is one of the NDIC/LRC's goals.

Reviewer 10-3 (Rating: 3)

The contributions could be significant. The project is specifically aimed at increasing mass transfer to enhance the capture of CO2. Improving mass transfer is certainly an area that needs to be addressed to improve the effectiveness of CO2 separation and capture systems.

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 10-1 (Rating: 5)

This proposer includes footnotes, references and a bibliography. The principal investigators involved in this work incorporate discussion of current research. The PIs are known to be knowledgeable in this area.

Reviewer 10-2 (Rating: 3)

The principal investigator's awareness of current research activity and published literature appears adequate.

Reviewer 10-3 (Rating: 3)

The principal investigators show a general awareness of the research being conducted. The proposal did not include a review of work conducted by other in this area. Much of the background information provided by NSG described their technology but did not adequately address research conducted by others.

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 10-1 (Rating: 5)

The PIs have exceptional backgrounds specific for the proposed work.

Reviewer 10-2 (Rating: 3)

The background of the investigators appears adequate. As a group, including the project advisor, they bring 10, 10, 6, 4, 3, and 0 (graduating next month) years of experience to the project, with the project manager having 4 years of experience. It is not clear from the resumes how much CO_2 capture experience the group has although the resumes indicate pilot-scale and other emissions type of experience. I would not hold the limited background against the team as everyone has to start someplace/sometime; however, a little more detail on their experience might make reviewers more comfortable, e.g., maybe a listing of relevant projects on their resumes even if they are not CO_2 capture specific but are related to pilot-scale testing and other emissions work.

Reviewer 10-3 (Rating: 3)

In general the principal investigators have experience in this area of research and technology demonstration.

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 10-1 (Rating: 4)

The project management plan is very good. Additional milestone charts and graphs could have been included.

Reviewer 10-2 (Rating: 2)

There is a chart illustrating which tasks individuals are responsible for; however, there is no milestone schedule, a financial plan, or plan for communications between investigators and the subcontractor. A 16-month, $2 million project needs more details. The subcontractor did provide details on schedule (for his 12 months of activity) but this was not for the entire 16 month project.

Reviewer 10-3 (Rating: 3)

Project management plan developed by EERC does not include NSG. NSG is an integral part of the program and clear project channels of communication and coordination must be planned. Milestones for EERC and NSG are clearly shown.

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 10-1 (Rating: 4)

The proposed purchase of equipment is well justified.

Reviewer 10-2 (Rating: 5)

The purchase of equipment is extremely well justified. EERC and the subcontractor provided very good details on the equipment purchased.

Reviewer 10-3 (Rating: 4)

The development of a pilot scale system that can be utilized in conjunction with the EERC CTF is well justified.

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 10-1 (Rating: 5)

The facilities and equipment available at EERC are exceptional.

Reviewer 10-2 (Rating: 4)

The test facility at EERC appears to be very good. The system that is proposed to be constructed also appears to be very good.

Reviewer 10-3 (Rating: 5)

Facilities at EERC and available from NSG are excellent.

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 10-1 (Rating: 4)

The proposed budget relative to the outlined work is a high value. There is some uncertainty with regard to the industry participants share (see page 31). Also, there is some inconsistency in the funding amounts. The Matching Funds paragraph (page 31), needs to be clarified. What sets the budget value of this proposed work high is the DOE matching share. ($1,935,156 - $1,530,000 = $405,156 not $312,473)

Reviewer 10-2 (Rating: 4)

NDIC's requirement that a minimum of 50% of the total cost come from other than Industrial Commission sources is definitely met, with a request of $50,000 from NDIC for a $2 million project. This is contingent upon DOE funding, which has been requested but has not been awarded yet. What is not clear though, is the NSG commitment. Initially it was stated that NSG was proposing to provide ≈$43,000, which I thought was low relative to the overall project size and potential benefits NSG will receive when the project is completed. However, later in the proposal there is reference to another ≈$122,000 from NSG which "... will undergo further cost analysis to determine an appropriate value." What does this mean? Also, the budget details are very good and illustrate the various cost estimates for the overall program. However, it is not clear from the budget details what senior management is or what they are doing. The budget lists 6 individuals as project manager, project advisor, and principal investigators. If these individuals are not considered the senior management, then some explanation should be provided on this category to account for the more than 10 weeks of labor.

Reviewer 10-3 (Rating: 5)

The financial commitment from other sources is very high relative to the NDIC/LRC commitment.

OVERALL COMMENTS AND RECOMMENDATION:

The Overall Comments and Recommendations have been deleted from this document because they included confidential information. The Overall Comments and Recommendations will be distributed during the confidential portion of the Lignite Research Council meeting.

[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.