

TECHNICAL REVIEWERS' COMMENTS

LRC-LXXII(73)-A:

“Demonstration of Multipollutant Reduction Using a Lextran 3-in-1 Wet Scrubber”

Submitted by: Energy and Environmental Research Center;

Request for: \$67,200; Total Project Costs: \$199,050;

Project Manager: Jay C. Almlie;

Project Duration: 10 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 12-01 (Rating: 4)

General and specific objectives are very clear. The general objective is to conduct pilot-scale combustion testing of the Lextran 3-in-1 gas cleaning technology using lignite-fired flue gas conditions at the EERC. The work proposed is Phase I. Phase II, field demonstration of the technology, is not included in this proposal. The specific objectives are: 1) to establish > 90% SO₂ removal across an ESP/wet scrubber and FF/wet scrubber, 2) to establish 60% to 90% NO_x removal across an ESP/wet scrubber and FF/wet scrubber, 3) to quantify the removal efficiencies of HCl and Hg across the ESP/wet scrubber and FF/wet scrubber, 4) to characterize the SO₃ emissions, 5) to determine optimum operating conditions, and 6) to compare Lextran with lime-based wet scrubber technology.

The general and specific objectives are consistent with LRC & NDIC goals and objectives. An explanation relating the proposal objectives and LRC/NDIC goals and objectives is not clearly shown in the proposal.

Reviewer 12-02 (Rating: 4)

Abstract talks about 99% SO_x removal, but best plan discusses targeting 90% SO₂ removal. Test plan and abstract should match and some in industry are required to have >95% removal.

Reviewer 12-03 (Rating: 4)

The development of an economical and effective technology to achieve high removals of different emissions without adversely affecting plant operations would be very valuable for utilities burning lignite. Such a technology should assure meeting existing and anticipated regulatory requirements and be compatible with future control of CO₂. In particular a technology that is capable high removals of NO_x, consistent with SCR performance is important for utilities burning Fort Union lignite, because of the problems that have been demonstrated for SCR. 99% SO_x removal is consistent with the requirements of downstream CO₂ capture and 98% reduction of mercury would be a very important development for lignite burning coal plants.

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 12-01 (Rating: 4)

Given the approach, time and budget presented, the objectives of the proposal are most likely achievable. The capability and experience of EERC and EPRI are well known. The parties should successfully evaluate the specific objectives.

Reviewer 12-02 (Rating: 2)

Hard to determine how successful it will be without test data.

Reviewer 12-03 (Rating: 2)

Very little information is given about the company that is developing this technology, nor is any of its staff included in the key personnel. Enough information should be given about this company and the staff that is working on developing this technology so that a judgment can be made as to whether they have the capacity continue the development of this technology to the point where it can be installed full-scale on a lignite-fired power plant.

Information on the technology, itself is very limited. The proposal claims that this technology has been demonstrated for SO_x/NO_x/Hg capture, but no further information is given. It would be useful to know the kind of application where the demonstration has occurred, at what scale and duration and whether any issues have been identified that need to be addressed in order to achieve further application of this technology.

Ozone is proposed for oxidizing NO. Ozone handling poses several challenges and the release of ozone from the stack would be problematic. An explanation should be give of why ozone was selected vs. other potential oxidants and how the ozone would be manage safely. There should be some discussion of whether there are other reactions that can consume ozone instead of oxidizing NO and how these would be dealt with.

There have been several multi-pollutant control technologies proposed where high levels of SO₂ and NO_x removal have been proposed. Generally, the NO_x reductions have been disappointing; there should be more discussion of how this process assures the desired NO_x reduction.

Little information is given about the catalyst. A potential four year life time is cited for the catalyst. There should be some discussion about the cost of catalyst make-up requirements and whether there are any environmental/health concerns associated with the catalyst use or its disposal.

The process diagram shows two by-product streams. One is described as small particulate matter, but the nature of this is not discussed or whether there is any catalyst present in this stream. The effect of varying particulate levels entering the scrubber result should be discussed, particularly on whether this may affect catalyst losses. Any environmental concerns with this material should be mentioned. The other stream is described as liquid fertilizer, but it is not clear how would this stream would be processed to result in saleable fertilizer. Lime is proposed as an alternative reagent to ammonia. If this is explored there should be some discussion of how the nitrate by-product be dealt with.

The potential for secondary emissions such as ozone and ammonia and how they would be handled should be discussed.

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 12-01 (Rating: 5)

The quality of the methodology displayed in the proposal is well above average. EERC and EPRI are seasoned in writing successful proposals. The general and specific objectives are clearly related. The specific objectives lead logically to specific tasks and subtasks. The statement of work is clearly presented.

Reviewer 12-02 (Rating: 4)

EERC's track record of qualifications and research activities is impressive.

Reviewer 12-03 (Rating: 4)

The approach proposed is suitable for the work considered and has proven effective in past test work.

Part of the test work is proposed adding ozone at different locations upstream of the scrubber to oxidize NO. There should be some discussion of how good mixing of the ozone in the flue gas is assured and the role of ozone vs. the process catalyst in oxidizing NO. Since the proposal places some emphasis on the role of the catalyst in oxidizing NO, it is not clear why the ozone would be introduced to the system at different locations upstream of the scrubber where the catalyst is.

Consideration should be given to monitoring ozone and ammonia at the PTC outlet as well as the O₂, CO₂, CO, SO₂, NO_x, HCl and SO₃ that are proposed.

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 12-01 (Rating: 4)

The proposal addresses several environmental rules presenting economic challenges for the North Dakota lignite industry. If the proposed economic and environmental goals are achieved, then the contribution of the proposed work could be very significant.

Reviewer 12-02 (Rating: 3)

Extremely significant if abstract is met; smaller if only goals are met.

Reviewer 12-03 (Rating: 4)

Should the work proceed as proposed and the results are as expected, this would be very important to lignite using utilities as an option with good potential will be identified for successful long-term emissions management.

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 12-01 (Rating: 4)

Reference to published and unpublished research is limited in the proposal. However, the work of the organization and PIs is well known. Review of U.S. Patent 6881243, "Method for removing acidic gases from waste gas" is a crucial element in understanding the Lextran process. There exist prior demonstrations of the technology and existing installation in the US and China. Results and information from these operations would be helpful.

Reviewer 12-02 (Rating: 4)

The PI has the EERC as support.

Reviewer 12-03 (Rating: 4)

The principal investigator demonstrates high awareness of emissions management issues and work that is occurring elsewhere to deal with this.

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 12-01 (Rating: 5)

The individuals and organization have exceptional backgrounds.

Reviewer 12-02 (Rating: 5)

Again, EERC has an excellent track record supporting the ND lignite industry through research. EERC's track record is impressive.

Reviewer 12-03 (Rating: 4)

The principal investigator(s) have demonstrated a solid background in the proposed work. However, better definition of the company developing the technology being investigated would be helpful.

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 12-01 (Rating: 5)

The elements of the proposal and SOW are exceptionally good.

Reviewer 12-02 (Rating: 3)

Test plan discussed one week of testing; project timetable shows 1.5 months. What else will be going on?

Reviewer 12-03 (Rating: 4)

The project management plan is clear and appears 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 12-01 (Rating: 5)

Note: Reviewer 12-01 provided no comments.

Reviewer 12-02 (Rating: 4)

Not much equipment necessary.

Reviewer 12-03 (Rating: 5)

The proposed work of project will largely be performed with already available equipment.

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 12-01 (Rating: 5)

The facilities and equipment available to the participant are exceptionally good.

Reviewer 12-02 (Rating: 4)

Have been used for other lignite testing effectively.

Reviewer 12-03 (Rating: 5)

The facilities and equipment proposed for this work is of high quality with a well-established track record.

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 12-01 (Rating: 4)

The proposed budget is of high value.

Reviewer 12-02 (Rating: 4)

Above the min. 50% will be funded elsewhere.

Reviewer 12-03 (Rating: 4)

The proposed budget is consistent with other successful projects of this nature that have been supported by NDIC.

Page # IV-A-2-5

OVERALL COMMENTS AND RECOMMENDATION:

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.

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 12-01 (Rating: FUND)

General comments: **FUND**

The strengths and merits of this proposal are:

- The experience and strengths of EERC and EPRI
- GRE is an experienced industry sponsor with excellent engineering capability
- The technology is new but not “unproven”
- The technology offers the potential of significant economic and environmental rewards
- The proposal is carefully crafted
- The proposal team is outstanding
- The proposal present clearly defined specific objectives, and
- the standards of success are clearly defined measureable benchmarks

The weaknesses and flaws of this proposal are:

- If successful the proposal carries an undefined Phase II with uncertain costs
- The technology if successful may mean coal, subbituminous or lignite but not necessarily ND lignite
- The “Lextran Catalyst” is of unknown or undefined composition, character, cost or availability
- The experience, results, data and status of the existing Lextran installations are not defined
- Industry commitment for Phase I and Phase II

My greatest concern are: 1) lack of detailed information from existing installations, and 2) information on the nature, availability and cost of the organic sulfoxide Lextran catalyst. With these concerns, I recommend the proposal for funding.

Reviewer 12-02 (Rating: FUND)

Not much discussion of activity relating to Hg reduction. That is now an important issue. I hope the project target for SO₂ removal is increased to at least 95% and believe as high as possible should be gone after for NO_x reduction as well. I recommend to fund.

Reviewer 12-03 (Rating: FUNDING MAY BE CONSIDERED)

The proposed work is high risk, high reward and relatively low cost and something that should be seriously considered. Successful completion of this project would provide lignite-burning utilities an important option for successful long-term management of its emissions, allowing the continued operation of lignite-burning power plants well into the future. However, there are several questions/concerns that should be addressed before a funding commitment is made.