TECHNICAL REVIEWERS' COMMENTS

LRC-LXXII(73)-B:
"Novel In-situ Sorbent Activation Process (SAP) – An Evaluation of North Dakota Lignite and Lignite Byproduct Feasibility to Reduce Mercury in Exhaust Gases Over an Extended Period of Time"
Submitted by: Great River Energy;
Request for: $400,000; Total Project Costs: $1,045,000;
Principal Investigators: Greg Archer, Charlie Bullinger, Ramsay Chang, Diane Stockdill;
Project Duration: 12-16 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 12-04 (Rating: 4)

The overall objective of the proposed project is to test the commercial application of EPRI's patented mercury control technology (SAP) at commercial scale and over a longer duration on North Dakota lignite at Great River Energy's Coal Creek Station. Specific objectives are; 1) to confirm that ND lignite is a viable feedstock for a commercially scaled SAP providing activated carbon (AC) for Hg control, 2) to evaluate the Coal Creek Station's baghouse fines that are collected from DryFine processing 3) to confirm SAP generated carbon will preserve ash sales, 4) to assess $CaBr_2$ optimization as a boiler additive versus as a SAP additive, and 5) to complete an economic analysis and provide a full-scale design.

Project objectives and goals are consistent with LRC/NDIC objectives and goals. While the objectives and goals are consistent, how they are related could be more clearly defined.

Reviewer 12-05 (Rating: 4)

The project does meet NDIC goals, particulary in the demonstration of a marketable product, activated carbon, with a high degree of probability.

Reviewer 12-06 (Rating: 4)

A bit choppy in how it is laid out, in multiple areas of the proposal, but where it is discussed, the clarity with how project objectives meet LRC/NDIC goals is well defined. The priorities are all mentioned and tied to project 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 12-04 (Rating: 4)

The objectives are most likely achievable given the approach suggested and time and budget available. GRE has significant experience with similar projects and should be able to achieve these goals.

Reviewer 12-05 (Rating: 4)

The project involves a commercial application of a patented mercury control technology. However, lignite has not been tested or long-term operation has not been conducted; this project should be beneficial to the commercialization process.

Reviewer 12-06 (Rating: 5)

The key concern would be the tear-down, transport and re-assembly of the system and having to replace or re-engineer its fit at the CCS. I think the testing expenses look reasonable, which is the area that LRC finds will be applied, as well as the economic analysis.

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 12-04 (Rating: 5)

The quality of the methodology displayed in this proposal is well above average. The general objectives and tasks are logically related and connected. The statement of work is reasonable developed and presented.

Reviewer 12-05 (Rating: 5)

The project builds on a proven technology, but with the use of lignite as a feedstock.

Reviewer 12-06 (Rating: 5)

EPRI backed, proven at other locations. Tested on other feedstocks. This is definitely a project that is trying to transition technology to utility scale and expand its use to the lignite sector of electric generation.

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 12-04 (Rating: 4)

If the proposed work is successful, then it could be very significant for the LRC/NDIC in meeting Mercury and Air Toxic Standards (MATS). In addition the project could define a new lignite by-product market.

Reviewer 12-05 (Rating: 4)

Capturing mercury will need to be achieved at all of the North Dakota coal-based generation facilities to meet the new EPA MATS regulations. If a process can be demonstrated to activate carbon at the plant site, control of the process and cost of the activated carbon should be a huge benefit to the North Dakota lignite industry.

Reviewer 12-06 (Rating: 3)

A new use for lignite which would be beneficial but the scale of additional use is likely small (< 5,000 tons/year per plant) unless the end product can be manufactured for sale to external entities, which the proposal alludes to but does not openly discuss.
– Preserves existing jobs.
- Likely creates minimal new jobs that wouldn't already be created.
- Attracts matching funds.

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 12-04 (Rating: 4)

Limited use is made to referenced or unpublished research. Ramsay Chang, Charlie Bullinger and Diane Stockdill are well known and respected in their respective fields. The referenced U.S. Patents are readily obtained from the Internet. Access to other EPRI and the MEGA Symposium references are not as readily available.

Reviewer 12-05 (Rating: 5)

The principal investigator has a long-term working knowledge of mercury removal and has a patented process.

Reviewer 12-06 (Rating: 5)

Again, EPRI backed. Much current research conducted on this technology and process already by EPRI. This project expands upon that research and brings it into the realm of lignite-fired electric generation.

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 12-04 (Rating: 5)

The backgrounds of the PIs are exceptional as related to the proposed work.

Reviewer 12-05 (Rating: 5)

Great team assembled.

Reviewer 12-06 (Rating: 5)

EPRI researchers. Partnered with GRE managers with much experience in technology research and commercialization.

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 12-04 (Rating: 4)

The project management plan and SOW are very good. Because of the multiple participants and PIs, an organization chart could help define roles, responsibilities and communications.

Reviewer 12-05 (Rating: 4)

I would have liked to have seen letters of support from other utilities in North Dakota.

Reviewer 12-06 (Rating: 4)

Well laid-out schedule and financial plan. No discussion of contingency for schedule lapse, over-run, or cost over-run.

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 12-04 (Rating: 5)

Note: Reviewer 12-04 provided no comments.

Reviewer 12-05 (Rating: 3)

It looks like half of the funding will be used for dismantling, transporting and re-installing the equipment. The other half of the funding will be used for demonstration purposes and evaluation of the effectiveness.

Reviewer 12-06 (Rating: 5)

Some expected equipment needs are mentioned but without detail as to what and without listing the equipment and costs individually, just a bucket of money for anticipated expenses. No equipment is listed as being paid for by LRC funds, only matching funds.

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 12-04 (Rating: 5)

The facilities and equipment available are exceptionally good.

Reviewer 12-05 (Rating: 3)

Facilities and equipment are readily available; additional equipment is not well documented.

Reviewer 12-06 (Rating: 4)

I'm anticipating their (EPRI's) SAP reactor is in good condition and for sure that the tie-in to GRE's CCS offers notably good conditions of equipment.

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 12-04 (Rating: 3)

The proposed budget is of average value – 1:1.

Reviewer 12-05 (Rating: 3)

The budget looks reasonable.

Reviewer 12-06 (Rating: 5)

Significant value is being achieved due to the use of the existing EPRI SAP reactor vessel. This would otherwise require substantially more investment. The financial commitment from the partners is reasonable in relation to the total project cost, and the partners are on the hook for cost over-runs.

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 12-04 (Rating: FUND)

Several factors combine to make this an outstanding proposal. The participants (EPRI and GRE) are experienced and have excellent reputations. The individual PIs are well known, respected and accomplished. The technology appears to be an ideal fit for GRE. The generation of activated carbon (AC) on site is ideal, as the highly active nature of AC is not compromised by shipping and storage. Lignite is known to be an ideal candidate for the generation of AC. The proposal is very good demonstrating engineering/management care and attention to detail.

There exist few weaknesses with this proposal. The limited involvement of Basin Electric, Minnkota and SaskPower may indicate lack of commitment or lack of potential for broader use of the technology. There was limited discussion on the potential adverse impacts from the use of bromides or bromine. U.S. Patent 6451094 and 6558454 are helpful in understanding the technology. These process and method patents provide additional descriptions of the SAP technology. Are any of the EPRI publications and papers available?

This is an outstanding proposal with a natural fit for ND lignite and GRE. I recommend funding.

Reviewer 12-05 (Rating: FUND)

Mercury capture using bromide activated carbon is actively being used today. I see the value of this project in utilizing lignite as a feedstock for the production of activated carbon and the ability to control the process at the site.

I would recommend funding for this project. The merits are that lignite can be used as a feedstock in producing activated carbon for the environmental capture of mercury. The EPA MATS regulation required all facilities to control mercury emissions.

[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 12-06 (Rating: FUND)

Recommended to fund. Overall a well-defined project to support a purpose needed by all lignite generation plants, and using lignite as a feedstock. The greater use to a larger market could have been further discussed to expand the value to the lignite commodity market.