

TECHNICAL REVIEWERS' COMMENTS

LRC-LXXV(75)-A:

“Advancing CO₂ Capture Technology: Partnership for CO₂ Capture (PCO₂C) Phase III”

Submitted by: Energy & Environmental Research Center;

Request for: \$500,000; Total Project Costs: \$5,398,000;

Principal Investigator: John Kay

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 13-1 (Rating: 4)

Clearly stated on page 4 and possibly more importantly, parallels what generators need to know going forward.

Reviewer 13-2 (Rating: 3)

It is clear that CO₂ capture meets the goals of the NDIC/LEC. It is also clear that tests will be made on various fuels, including lignite. Not clear on what proportion will be lignite

Reviewer 13-3 (Rating: 3)

The EERC has not chosen specific technologies to study nor have they decided what tests to conduct. Nor have they provided clear criteria for making that selection. The EERC does not appear to have clear objectives regarding cost reductions they are striving for. In addition, they have not made the case that certain types of carbon capture technologies are more likely to succeed and therefore are worthy of their evaluation. They seem to be taking a shotgun approach by studying oxyfuel, gasification, and various forms of post combustion capture. They have not made a clear case that they are focusing on the study of technologies which will likely have a competitive advantage. For instance some people believe that step changes in cost reduction will be required before CCS is adopted and that liquid solvents will only offer modest improvements in cost. In my view it is unlikely that IGCC will be competitive with other forms of carbon capture on new coal combustion facilities.

I like the fact that they have included partial capture options. Recently the EPA proposed a requirement for coal plants to partially capture CO₂ with no provision to sell the benefits associated with over compliance. If this with the way forward, I would expect the EERC to drop testing technologies which are clearly not well suited to partial capture and refocus on ones which are.

Given it is not clear what they will be doing, it is hard to conclude that their tests will yield results consistent with your 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 13-1 (Rating: 3)

Can be achieved but depends highly on the number of technologies tested. Not clear how big this group will be. Advisory Committee very important.

Reviewer 13-2 (Rating: 4)

Note: Reviewer 13-2 provided no comments.

Reviewer 13-3 (Rating: 4)

The EERC has demonstrated during previous Phases that they know how to conduct research programs. They have however missed some deadlines. Also given it is not clear what technology they will research and what they will evaluate for each technology, it is not possible to conclude that they can certainly achieve their objectives.

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 13-1 (Rating: 4)

EERC has been through this many times. No issues with methodology.

Reviewer 13-2 (Rating: 2)

The methodology is vague, especially in regards to lignite.

Reviewer 13-3 (Rating: 4)

One of the key concerns associated with this proposal is the methodology used to determine which projects will be funded. The EERC might be motivated to work with entities which provide funding even though those technologies may not be winners or may wish to keep certain features of the research confidential which has happened in the past. Therefore I would encourage the Lignite Energy Council to take an active role in the decision making process. In addition, I would encourage the Lignite Energy Council/EERC to seek advice from third parties like EPRI or others to comment on the technologies being contemplated and to suggest technologies to consider.

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 13-1 (Rating: 5)

ND generators mining customers should all have a clearer understanding of what might work and what it will cost!

Reviewer 13-2 (Rating: 2.5)

CO₂ capture is very important/ the applicability to lignite coal and North Dakota power plants for commercial development is less clear, since more solvent research may not be beneficial with already trademarked products.

Reviewer 13-3 (Rating: 4)

If CCS is to become an option to keep existing coal plants running and to facilitate the construction of new plants to meet expected GHG regulatory requirements, research must be conducted to find lower cost CCS options than are currently available. The EERC is one of only a handful of test facilities conducting this type of research in the US. In my view they have conducted very valuable research in this area in the past. Whether, they will find CCS technologies which are economically viable remains to be seen.

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 13-1 (Rating: 4)

Much prior work done at EERC on this, so... "Yes," but encourage them to screen prior DOE/EPRI/other work to avoid technologies that didn't work, deemed too expensive or duplicate what someone else has done.

Reviewer 13-2 (Rating: 3)

Not obvious how phases I and II are linked with phase III.

Reviewer 13-3 (Rating: 4)

They did not identify research on a few key technologies, including a few they are working on, as shown on page 21. I know from working with them that they have evaluated dozens CO₂ capture technologies based on information available in the public domain. They could have compared their results to work of others or distinguished the EERC from other labs doing similar work.

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 13-1 (Rating: 4)

EERC has a great group of experienced people and facilities needed to accomplish this issue.

Reviewer 13-2 (Rating: 3)

Interesting there are no Ph.D.s to do evaluations. OK with staff identified to do testing. Hours listed in proposal, Appendix B are different than in proposal.

Reviewer 13-3 (Rating: 5)

The EERC is one of a few test facilities of its kind in the world. They have a good understanding of what needs to be tested to help advance CCS technologies. They also have several years of experience conducting very credible and substantive testing of carbon capture technologies. That is why many technology developers have chosen to have their technology evaluated at the EERC labs and by EERC staff.

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 13-1 (Rating: 4)

Again, EERC is very qualified, having this same type of project management many times.

Reviewer 13-2 (Rating:2)

Project schedule is not robust. Expand to include 10-15 line items with tasks (sub-tasks) with associated schedule and budgeted cash flow and key communication points in testing and analysis.

Reviewer 13-3 (Rating: 4)

Given they have not decided what technologies to test, it is not clear what needs to be evaluated to advance the development of each technology. However, given their previous phases of work, they have a good understanding of what needs to be evaluated for new technologies. Also, for technologies which will be brought back for phase III, they should have a good idea what else needs to be evaluated to move the technologies forward.

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 13-1 (Rating: 3)

Presume other equipment at EERC cannot monitor flue gas like the FT-JR can? Understanding complex chemistry is paramount. Are there any zero-discharge facility issues/economics to also include??

Reviewer 13-2 (Rating: 5)

Not clear if equipment will be purchased with grant dollars. Proposal indicates new equipment, but budget doesn't show any money for equipment with NDIC.

Reviewer 13-3 (Rating: 5)

Most of the proposed test work will be completed on existing 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 13-1 (Rating: 4)

Looks like a thoroughly thought out plan. Facilities and equipment there are 1st class, particularly interested in any inlet requirements and downstream affects and costs for each.

Reviewer 13-2 (Rating: 4)

Yes, good facility.

Reviewer 13-3 (Rating: 5)

I have recently toured the EERC facilities. They have a lot of high quality equipment. Some of the equipment is at the lab scale and some is capable of pilot scale demonstration. The few pieces of equipment, they propose to purchase, will increase their capacity to complete further important evaluations. However, I would like to see them work more closely with other labs. Other labs may be able to complete work jointly with them to offer a more fulsome evaluation of a given technology.

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 13-1 (Rating: 4)

The value is there but would like to have confirmed that kilns, fertilizer plants, NGCC plants, gas processing plants, industrial processes as well as technology providers are also financially committed.

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 13-2 (Rating: 3)

It is understood that financial commitment from other sources is expected. Consider that Task 3, Aspen Software will be used and available relevant to lignite.

Reviewer 13-3 (Rating: 4)

The Lignite Energy Council will achieve high leverage for the fee to join Phase III. That is by contributing about 10% of the budget you will receive the benefit of a lot of research funded by others. I do however worry that they complete evaluations on technologies for which the underlying technology is not identified. For instance Figures 7 and 8 show solvents identified by letter. This makes it very difficult for funders to make decisions based on this information.

Third-party money is being used to help a licensor develop a technology and only they truly benefit from the results.

In addition, for some of the technologies, relative rather than absolute results are provided at the request of the licensors. Relative results are difficult for third parties to work with and serve to protect the interest of the licensors.

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 13-1 (Rating: FUND)

Phase III appears to be a very good and qualified follow-up to I and II. Advisory Committee's input is critical.

Reviewer 13-2 (Rating: FUNDING MAY BE CONSIDERED)

Basically, the overall project involves all coal types, natural gas, "ret" coke, biomass. Does not specifically identify what portion is lignite coal per NDIC/LEC requirements.

Funding may be considered if:

1. Other funding is secured, per requirements.
2. Lignite coal is tested and evaluated in proportion to amount granted, per requirements.
3. Aspen Software output is included with deliverable.
4. More robust scheduled of work items and cash flow.
5. Address connection between phases I and II with phase III and incorporate the findings from these other phases into phase III.

Reviewer 13-3 (Rating: FUND)

I have the benefit of seeing some of the Phase II results. Having access to the final Phase II results report would have made it easier to make some of the conclusions in this evaluation.

Many of the evaluation criteria are really relative to your other options. The Lignite Energy Counsel could have entertained proposals from other test facilities. The assessment of more than one proposal at a time would make it easier to rank the options compared to the criteria.

My clients and I have valued the work conducted by the EERC in the past. The EERC has good facilities, good staff and has produced good and useful research which has advanced the development of lower cost CCS technologies. I believe that in Phase III they will advance the development CCS technologies which will help reduce the cost of CCS. Therefore, I recommend that the Lignite Energy Counsel fund the Advancing CO2 Capture Technology: Partnership for CO2 Capture (PCO2) Phase III proposal.