

TECHNICAL REVIEWERS' COMMENTS

LRC-LXVIII(68) –A: “Lignite Catalytic Hydromethanation Development Project”

Submitted by: GreatPoint Energy

Request for: \$3,923,884; Total Project Costs: \$7,847,769

Amended Request: Phase I \$458,500; Phase II \$3,489,079 (\$3,923,884)

Amended Request: Phase I total \$917,000; Phase II \$6,978,158 (\$7,895,158)

Principal Investigator: Patabhi Raman

Project Duration: 17 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 09-13 (Rating: 4)

GreatPoint Energy has been involved in the development of a proprietary hydromethanation process to produce Synthetic Natural Gas (SNG) from solid fuels. They have developed bench and pilot scale facilities which they operate for purposes of further development of their technology and qualification of potential feedstocks. In this Phase 1 proposal, they propose to begin the process of qualifying North Dakota lignite as a suitable feed for their process. If they are technically successful in developing this technology to a commercial scale and it proves to be competitive with other sources of natural gas and synthetic natural gas, there is a potential for the creation of an additional market for North Dakota lignite as well as additional SNG production facilities in North Dakota that could result in a significant number of new jobs.

Reviewer 09-14 (Rating: 3)

The GPE revised grant request specifies clearly the potential positive implications of their technology upon North Dakota's lignite industry – if the research results of Phase I (and later Phase II) confirm the efficacy of this technology.

Reviewer 09-15 (Rating: 3)

The GreatPoint Energy group is developing a proprietary coal-based hydromethanation process to convert coal (lignite) to pipeline-quality natural gas or hydrogen. The proposed process would capture CO₂ that could be sequestered or for enhanced oil recovery. Air emissions would be converted to elemental sulfur and ammonia and no waste residues (tars, oils). Compared to gasification technology, catalytic hydromethanation conversion is touted as a more efficient technology.

The project goals are consistent with NDIC 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 09-13 (Rating: 3)

Please see comments in Section C about restructuring the proposal to provide estimated product costs as a Phase 1 deliverable. The two major tasks in Phase 1, Task 1 (Hydromethanation Process Development) and Task 2 (Process Modeling) are analogous to previous work that they have done on coal and petroleum coke. They should have been able to accurately predict the cost and duration of this work.

Reviewer 09-14 (Rating: 4)

A six month schedule to complete Phase I should be do-able; however, undesired results and/or challenges arising from coal moisture and/or lignite mineral content could lead to inconclusive outcomes in this research effort. Nevertheless, it would seem that the proposed work could be performed in the proposed time period.

Reviewer 09-15 (Rating: 3)

The proposers state that ND lignite should be more reactive than PRB and petcoke, and that a significant amount of lignite bench scale work has been done in GreatPoint's laboratory. It is suggested that the proposers provide the test data results and appropriate publications.

It is further suggested that the laboratory scale be limited and that as least two lignite's be representative of the varying lignite properties in current use.

The total cost of \$6,978,158 (LEC \$3,489,079).

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 09-13 (Rating: 4)

The proposal is well organized. They are well aware of the technical and economic (lignite handling, kinetics, fluidization behavior, catalyst recovery, ash and mineral matter issues, etc.) challenges of hydromethanation technology and have selected promising approaches for dealing with them. Their plan for dealing with these issues is quite detailed with reasonable time allocations for the tasks.

Reviewer 09-14 (Rating: 4)

The previous process investigative/development work conducted by GPE over the years has resulted in a research discipline that is evident in their proposal. Their approach appears logical, thorough, and practical. Their PI is clearly a highly qualified professional with an exemplary resume.

Reviewer 09-15 (Rating: 2)

It was difficult to characterize the proposed effort, however, it is suggested that the results of the laboratory data be complete and present the information to the lignite industry prior to proceeding to the pilot scale program.

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 09-13 (Rating: 4)

The value of this work is that it will provide an assessment of how lignite will perform in this hydromethanation system relative to other feedstocks including coal and petroleum coke. It will be the first time that data of this type has been obtained with North Dakota lignite with the specific catalysts and operating conditions utilized in the “bluegas™” system.

Reviewer 09-14 (Rating: 2)

It is unlikely the Phase I research results will directly and imminently lead to increased use of ND’s lignite; nor will this current research create jobs in the State. However, this research effort could potentially result in a positive step toward developing another conversion technology for the lignite industry.

Reviewer 09-15 (Rating: 4)

If the catalytic hydromethanation process is successful, it could generate jobs, construction activity, be more efficient, more environmentally compatible and reduce CO2 emissions.

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 09-13 (Rating: 4)

The proposal did not include references to any work other than that of GreatPoint Energy. All of the discussion was limited to technical issues in their system. As noted previously they displayed a comprehensive understanding of those issues.

Reviewer 09-14 (Rating: 4)

Based on the PI’s credentials, taken together with listed literature references and the context of the GPE proposal, it is apparent that the Principal Investigator is highly aware of challenges associated with lignite when compared to other coals already tested in the Bluegas system.

Reviewer 09-15 (Rating: 3)

No reference to published literature was provided. However, internet information reflects several major organizations are associated with the catalytic hydromethanation process and support and participate to maintain an association with the emerging technology. Additionally, the proposers constructed a large scale pilot plant (Mayflower facility) to further develop the process.

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 09-13 (Rating: 4)

The team that has been assembled appears to be well qualified to execute the proposed program. The specific work to be done under this project is analogous to previous program on coal and petroleum coke.

Reviewer 09-14 (Rating: 5)

GPE's Principal Investigator has apparently been with their program throughout most of the gasifier's ownership by that organization. He is, therefore, highly aware of its strengths improvement needs.

Reviewer 09-15 (Rating: 4)

Pattabhi Raman, PI, has 25 years in developing and scaling new technologies in the chemical and hydrocarbon industry.

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 09-13 (Rating: 4)

The project management plan is very detailed and appears reasonable in duration and scope. The schedule and milestones are appropriate.

Reviewer 09-14 (Rating: 3)

The project milestone chart appears adequate for Phase I; however, there is no evidence of a specific protocol for communication within GPE's investigative team (including subcontractors). There is mention of the PI's intent to keep the NDIC abreast of research developments on this project, however.

Reviewer 09-15 (Rating: 3)

Very difficult to read....suggest a readable copy be provided prior to the LEC meeting.

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 09-13 (Rating: 5)

I have assumed that all the equipment required for the experimental and modeling work is currently available and no additional equipment is required

Reviewer 09-14 (Rating: 5)

For Phase I it appears that limited or no equipment will need to be purchased. The experimental work would be done primarily in existing facilities, and the referenced modeling software already exists within their organization.

Reviewer 09-15 (Rating: 3)

Roughly \$2,260,000 is required to upgrade 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 09-13 (Rating: 4)

All of the facilities and equipment to be used in this project has been previously used for analogous work on coal and petroleum coke.

Reviewer 09-14 (Rating: 3)

Short of performing an audit, the descriptive and pictorial description of GPE's facilities as pertaining to being "adequate" for Phase I of this research, appear satisfactory or better.

Reviewer 09-15 (Rating: 4)

Overall, a significant amount of equipment will be required.

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 09-13 (Rating: 5)

This rating is based on GreatPoint Energy's proposal to fund 50% of the project.

Reviewer 09-14 (Rating: 4)

Considering the technical and administrative staff listed who will conduct the proposed Phase I research, it would seem to this reviewer that a high value will be derived from the expenditure. The PI and support staff appear highly qualified and diversified in their disciplines, which when combined should yield a focused research effort with a credible outcome.

Reviewer 09-15 (Rating: 3)

The financial commitment from other sources is %50 - %50

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 09-13 (Rating: FUNDING MAY BE CONSIDERED)

Funding for this proposal may be considered.

My reservations about this proposal are that the results of the work on Tasks 1 (Hydromethanation Process Development) and Task 2 (Process Modeling) will not be used within Phase 1 to do any work on Task 5 (Economic and Risk Evaluation). Task 5 work is not scheduled until Phase 2. In my opinion, the most valuable information in terms of usefulness to NDIC is the estimated cost of the SNG product that would

IV-A-2-5

result from the utilization of lignite as the feed for this process. With that information in hand, the NDIC could make an informed judgment about whether or not additional R&D investment in this technology would have potential future value.

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.

Great Point Energy proposed in their original proposal to perform an unphased R&D program that would qualify North Dakota lignite as a feedstock for their “bluegas™” catalytic hydrogasification process. They stated in that proposal that “we estimate a lignite-based commercial plant could produce SNG at \$4-\$5/MMBTU production cost”.

They submitted an amended proposal for a limited scope, seven month Phase 1 project, that would focus on “laboratory development, process model development and pilot scale design engineering activities, all of which will demonstrate readiness for continuous and pilot scale testing” in a much more extensive and larger scope Phase 2 program.

At this time, natural gas near futures contracts are in the range of \$3.50 to \$4.00/MMBTU, markedly lower than the peak range of \$10-13/MMBTU experienced over the last year or so. The two major reasons for these lower prices are the reduced level of economic activity in the US, which has reduced demand, and the emergence of increasing supplies of natural gas produced from deep shale formations at competitive prices as a result of using advanced technology for horizontal drilling and hydraulic fracturing of the shale formation, which has markedly reduced production investment costs. Recent predictions are for a large increase in natural gas production from deep shale resources in the future. How long this increase in production can be sustained and its impact on future gas prices cannot be determined at this time. However, it is prudent to consider these issues when making R&D investment decisions for a technology that has a currently estimated product price above today’s near-term future contracts and that most probably will not be available in the US for more than 10 years, considering the normal cycle for financing, permitting, engineering, construction, and start-up operations required to bring a new first-of-a-kind (lignite hydromethanation) plant on stream.

With that being said, there is value in obtaining preliminary data on a different approach to utilizing North Dakota lignite for SNG production with a technology that is projected to produce SNG at a lower cost than the current Dakota Gasification plant and perhaps other approaches to SNG production as well. Therefore strengthening the proposed project by carrying out Task 5 (Economic and Risk Evaluation) work based on data, obtained during Phase 1, during Phase 1, should enhance the value of the Phase 1 project.

Funding for that Task 5 work could be obtained by deferring Task 3 (Mayflower Conversion and Retrofit) until the beginning of a future Phase 2 program. The estimated costs of Tasks 3 and 5 are almost equivalent.

Reviewer 09-14 (Rating: DO NOT FUND)

The comments of Reviewer 09-14 will be distributed during the closed portion of the meeting as the reviewer’s comments include confidential information.

Reviewer 09-15 (Rating: FUNDING MAY BE CONSIDERED – See General Comments)

General Comments: Do not fund the total effort.

The total project cost \$6,978,158. The LEC cost share would be \$3,489,079

Approximately \$2,300,000 of process upgrades and equipment are required for pilot-scale operation.

Considering the lack of data and conclusions regarding ND lignite, it is suggested that a limited laboratory scale test be conducted using two lignites of varying characteristics.

Funding may be considered to conduct a lignite test at the limited laboratory scale development.

An estimated cost effort may be provided prior to the November LEC meeting.