

# TECHNICAL REVIEWERS' RATING SUMMARY

R021-B

## Distributed Geothermal Power

University of North Dakota

Principal Investigator: Michael Mann

Request for \$100,230; Total Project Costs \$200,835

<u>Rating Category</u>	<u>Weighting Factor</u>	<u>Technical Reviewer</u>			<u>Average Weighted Score</u>
		<u>1A</u>	<u>1B</u>	<u>1C</u>	
1. Objectives	9	4	5	3	36.00
2. Achievability	9	4	5	4	39.00
3. Methodology	7	4	4	3	25.67
4. Contribution	7	4	5	1	23.33
5. Awareness	5	3	5	3	18.33
6. Background	5	4	5	4	21.67
7. Project Management	2	3	4	4	7.33
8. Equipment Purchase	2	2	5	4	7.33
9. Facilities	2	3	5	3	7.33
10. Budget	2	3	4	4	7.33
<b>Average Weighted Score</b>		185	239	156	<b>193.33</b>
<b>Maximum Weighted Score</b>					<b>250.00</b>

### OVERALL RECOMMENDATION

FUND	X	X	
FUNDING MAY BE CONSIDERED			X
DO NOT FUND			

R021-B  
Distributed Geothermal Power  
Submitted by University of North Dakota  
Principal Investigators: Michael Mann  
Request for \$100,230; Total Project Costs \$200,835

- 1. The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Renewable Energy Council goals are: 1 – very unclear; 2 – unclear; 3 – clear; 4 – very clear; or 5 – exceptionally clear.**

Reviewer 1A (Rating: 4)

The three primary objectives align well with the Council's goals of developing renewable technologies in ND

Reviewer 1B (Rating: 5)

This project meets the goals of the NDIC as shown by the following examples.

NDIC Goals: Promotes efficient, economic and environmentally sound development, create job, promote new technologies, increase public awareness, and add landowner wealth. = This project uses geothermal energy and demonstrates new technology as a solution for the current electrical needs of the Williston Basin o/g development, thus reducing infrastructure demand in the area, and the long-term outcome is expected to increased jobs in the area to maintain this environmentally sound project. The landowner will be able to receive royalties for the geothermal fluids produced, and have a smaller impact on their land than if no geothermal development took place.

Reviewer 1C (Rating: 3)

The project proposes to report on a technology that would be primarily located on oil/gas drilling sites. The goal of the project is create an economically viable (profitable) side enterprise (geothermal electricity production). If this goal is achieved, the oil and gas well owner is likely increase their profitability and possibly extend the life of each well or operate a well that may have been economically marginal. Either of these may lead to increased oil/gas production which is likely to increase emissions.

- 2. 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 1A (Rating: 4)

With the ORC system already built the proposal's goal of achieving installation should be readily achievable. However, my main question is, why hasn't this yet been installed? What have been the holdups? Was it simply lack of funding (which at \$200k is small relatively to the capital already invested) or some technical or engineering challenges? The project initially began in 2010 and I saw a DOE presentation online saying that it should have been complete by early 2013. What happened?

Reviewer 1B (Rating: 5)

The fact that this project is already funded except for this last piece related to installation costs, means the lion's share of the effort is already completed. The DOE and ND Geological Survey both have specific requirements that must be met to have a project funded and these are usually competitive processes. To have passed these higher levels of standards to receive the primary project funding is a very strong commitment of funding, but also support from the agencies to make sure this project succeeds. The timeline of installation is reasonable. The main requirements are currently to connect the well to the equipment.

Reviewer 1C (Rating: 4)

It appears the bulk of the work is done except for installation. Installation should be easily attainable. The only other goals are to collect data and disseminate the results. The data collection should be easily attainable. Effective dissemination of results will depend of the efforts of the project team but is attainable.

- 3. 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 1A (Rating: 4)

Methodology described is fairly simple – install and then monitor for performance. It'd be helpful to better understand the interactions among CRI, Access, UND and DOE to better understand who is responsible for what. Things will inevitably go wrong (and utility scale geothermal has a mixed track record), so who is responsible for what?

Reviewer 1B (Rating: 4)

The installation process is not considered “new technology”, so what is required to hook up the Access Energy's boxed equipment to the Continental well does not need to have much detail. Other similar systems have been installed in Mississippi with the ElectraTherm Green Machine and Denbury Resources and the process took less than a week.

Reviewer 1C (Rating: 3)

The technical/engineering aspects of the project are very solid. The proposal could be strengthened in several ways. 1) Provide additional details about who the target audience is for your information and why they would be interested. 2) Additional information about the contracts for connecting to the electrical grid would be valuable. An electric utility partner would be appropriate.

- 4. The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Renewable Energy Council goals will likely be: 1 – extremely small; 2 – small; 3 – significant; 4 – very significant; or 5 – extremely significant.**

Reviewer 1A (Rating: 4)

The overall resource is large, but the thing that isn't really clear is whether or not this solution is intended exclusively for on-site electricity demand or if it's also meant to be grid-connected. If the latter, how do you aggregate wells and interconnect? If just the former, are customers

expected to purchase the systems outright or will they be owned by 3<sup>rd</sup> parties? It's a very interesting contribution from a technical perspective, but you have some interesting deployment and customer challenges that aren't really addressed here...

Reviewer 1B (Rating: 5)

The NDIC name associated with this project will bring positive press and awareness to your organization world wide. The 6 month SMU on-campus demonstration in 2005 of the Green Machine continues to be mentioned in press releases and connects us with researchers and companies world-wide. The geothermal community and even more the oil and gas community will largely benefit from the demonstration reports, meeting discussions, and industry conversations about this technology. Although there have been other similar demonstrations in MS and WY to have one in the middle of ND where so much activity is happening will be significant for the NDIC to promote and to teach others about renewable energy – specifically geothermal energy.

Reviewer 1C (Rating: 1)

It is very possible that the major benefactor of this project will be the oil/gas industry, rather than the geothermal industry.

**5. 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 1A (Rating: 3)

**No comment included.**

Reviewer 1B (Rating: 5)

A review of these PI's research on Google Scholar quickly shows that Michael Mann, Will Gosnold and Hossein Salehfar are strong researchers, they have worked together on other projects and are capable of getting the installation completed, use the research results for publications, have students and others involved, and make a difference in the oil/gas and geothermal community with this demonstration. Within the geothermal community Will Gosnold is considered a leader in the field. His students go on to be involved in projects and contribute to the science and technology that moves the entire industry forward.

The presentation Will Gosnold gave at our Geothermal Utilization Conference a few years ago is one of the top downloads of all the presentations.

Reviewer 1C (Rating: 3)

The project is very strong from the technical/engineering aspects. The business plan and economic analysis are not very detailed in the proposal, particularly in terms of identifying risks or policy concerns that may impact the project (changes in ITC, net metering rules vs. wholesale generation, etc.).

**6. 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 1A (Rating: 4)

The PIs are very well positioned to tackle the technical challenges.

Reviewer 1B (Rating: 5)

With the management of the project spread out over three people, with Michal Mann being the key PI, this team represents one that understands no one person can do it all. The UND Engineering Dept has shown they have a strong work ethic and creative thinking to have even made it this far. I regularly interact with individuals/companies who want to find an o/g well to put a binary plant on, and never complete the task.

Reviewer 1C (Rating: 4)

Again, the project very solid on the engineering and technical aspects but may benefit from strengthening the business/economics side of the project team.

**7. 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 1A (Rating: 3)

This was aspect was pretty thin – most of the points were addressed but at an incredibly high level.

Reviewer 1B (Rating: 4)

As mentioned above in section 3, the installation process which this proposal is describing is only a small portion of the overall project. Therefore the management plan, the timetable and budget are all reasonable. From another project I have been working on with the North Dakota Geological Survey related to well logging, it has been discussed that the pricing of everything related to building and construction has increased rapidly in the past few years as the boom of the oil/gas industry is overwhelming the system. It is difficult for me to be able to determine if the actual numbers for the piping, valves, etc are reasonable, yet there is no benefit to the project to have inflated numbers as the project management salaries are from other sources. It is important to have enough funding to be able to get the installation completed once started, so to compensate for still increasing pricing of contractors, there should be some additional funding requested that may or may not be spent.

Reviewer 1C (Rating: 4)

The communications of the results could be clarified further in the proposal. Who are the decision makers that might invest in this type of project? Is it an oil/gas company, the well driller, a utility company, a third party firm? Will the project results reach these decision makers?

- 8. 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 1A (Rating: 2)

I just don't have much basis here judge – the majority of purchases are piping and fabrication installation. That intuitively makes sense but a more detailed explanation of the installation process and requirements would be helpful. I thought the unit was already constructed, and from the proposal description the installation was fairly easy / flexible (requires no concrete bed and just needs hot water at pressure). Not to diminish the complexity of that, but how plug and play can this really be if each install requires \$200k of additional piping and fabrication? The \$3000/kW capital cost equates to \$750k for a 250kW system – does that already include that additional \$200k?

Reviewer 1B (Rating: 5)

See above #7.

Reviewer 1C (Rating: 4)

It appears most of the equipment for this project is already purchased and in place. This project only provides from some pipes/fitting and their installation.

- 9. 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 1A (Rating: 3)

I'm giving an adequate mark here, simply because the proposal is (very smartly) outsourcing unit production and the vast majority of the first system has already been completed, but similar to above there should be a better description of both Access Energy itself as a partner and the track record of their packages system.

Reviewer 1B (Rating: 5)

The piping, valves, strainers, etc are common items and if not currently available from ND suppliers, will be available from other states.

Reviewer 1C (Rating: 3)

**No comment included.**

- 10. The proposed budget “value”<sup>1</sup> relative to the outlined work and the financial commitment from other sources is of: 1 – very low value; 2 – low value; 3 – average value; 4 – high value; or 5 – very high value. (See below)**

Reviewer 1A (Rating: 3)

Pipes and valves are what they are, so hard to argue with those figures.

<sup>1</sup> “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.

<sup>2</sup>Financial commitment from other sources – A minimum of 50% of the total project must come from other sources to meet the program guidelines. Higher priority is to be given if the application has private industry investment equal to or at least 50% or more of total cost.

Reviewer 1B (Rating: 4)

To be able to fund ~\$100,000 of a project over \$3.7 Million with the commitments from Department of Energy, Access Energy, Continental Resources, ND Geological Survey, and University of North Dakota is over extreme value to the NDIC and your goals. The long-term potential for benefitting ND's electrical grid, reduction in CO<sub>2</sub>, new job opportunities, and positive press showing the world how ND is capable of being a leader in the renewable energy industry is one that I would certainly say yes to.

<sup>1</sup> "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.

<sup>2</sup>Financial commitment from other sources – A minimum of 50% of the total project must come from other sources to meet the program guidelines. Higher priority is to be given if the application has private industry investment equal to or at least 50% or more of total cost.

Reviewer 1C (Rating: 4)

This project is clearly a small add-on project to a much larger project. This can be looked at in two ways. 1) Funding this proposal is great way to leverage a large pool of "additional" resources. 2) This project will proceed and achieve the same results due to the strong commitment from the current project partners and thus funding this proposal is not essential.

<sup>1</sup> "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.

<sup>2</sup>Financial commitment from other sources – A minimum of 50% of the total project must come from other sources to meet the program guidelines. Higher priority is to be given if the application has private industry investment equal to or at least 50% or more of total cost.

**Section C. Overall Comments and Recommendations:**

**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 1A (Fund)

The project has already received a substantial amount of funding and does appear to be on the cusp of what would be some very valuable technical proof points. If the goal of the funding is purely technical validation then this deserves funding, but regardless, the team might want to consider bringing on an additional resource (perhaps even just as an advisor) to begin thinking through business model possibilities as well.

Reviewer 1B (Fund)

This project will make a significant contribution to the research community, the oil and gas industries ability to understand how to reduce their impact on the land, and the state of North Dakota as the leader in the development of geothermal energy within an oil and gas field.

Supporting Continental Resources Inc. in their commitment to assist in the project is noteworthy. The oil and gas industry does not like being the front man unless the wildcatting ends up successful. It is very difficult to get the oil and gas companies to even come to the table for a discussion, no less be willing to have their well used for a demonstration.

This project meets all the goals of the NDIC as outlined in the material sent to me, therefore, I highly recommend this project be funded and your support of it is given in your fullest capacity.

**Reviewer 1C (Funding May Be Considered)**

**Strengths:** This proposal would support a project that has a current team that has worked together and all team members have made significant financial contributions to the project in the past and likely will in the future. The project team is very strong on the engineering/technical aspects of the project. The F&A rate is low. The potential for the project, if profitable, to be replicated at other numerous well sites is high.

**Weaknesses:** The primary beneficiary of the project may be the oil and gas industry. The project does not address the complex policy issues that surround the regulated electrical industry. Federal policies, state policies, regional suppliers (example: MISO) and Utility company policies all have the potential to have significant impacts on the economic viability of this type of project, yet they are barely mentioned in the proposal. This project is likely to proceed even if this proposal is not funded. The main equipment has already been purchased; it seems unlikely that the equipment will be allowed to remain uninstalled. The only portion that appears not to be critical to the current project is the dissemination of information, which the proposal is not requesting any funds to support.

**Recommendation:** The project has great potential to benefit the economic interests of oil and gas producing areas of North Dakota and the U.S. The project's benefits to the environment are less clear. Due to the reasonably high probability of the project being replicated at many other well sites if the project is economically viable, I recommend funding this project.