

TECHNICAL REVIEWERS' RATING SUMMARY

R008-A

Bulk Energy Storage for ND Wind Energy Integration

Dakota Salts

Principal Investigators: Dakota Salts LLC, EPRI, Schlumberger, Tetra Tech.

Request for \$225,000; Total Project Costs \$570,000

<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	3	4	4	33.00
2. Achievability	9	3	2	4	27.00
3. Methodology	7	4	3	5	28.00
4. Contribution	7	4	3	3	23.33
5. Awareness	5	2	3	3	13.33
6. Background	5	3	5	5	21.67
7. Project Management	2	3	4	4	7.33
8. Equipment Purchase	2	5	5	5	10.00
9. Facilities	2	3	5	5	8.67
10. Budget	2	4	3	3	6.67
Average Weighted Score		165	170	202	179.00
Maximum Weighted Score					250.00

OVERALL RECOMMENDATION

FUND	x	x
FUNDING MAY BE CONSIDERED	x	
DO NOT FUND		

R008-A
Bulk Energy Storage for ND Wind Energy Integration
Submitted by Dakota Salts, LLC
Principal Investigators: Dakota Salts, LLC, EPRI, Schlumberger, Tetra Tech.
Request for \$225,000; Total Project Costs \$570,000

- 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: 3)

The objectives are fairly clear, however I would have liked to read a little detail about the ‘total value proposition’. What assumptions are to be made about the electrical market? Will it grow? Is there transmission to get significantly more energy to load centers like Chicago and St. Lois?

Reviewer 1B (Rating: 4)

The project is in line with the goals of the Renewable Energy Council. The project strives to identify a potentially valuable facility that could enhance the expansion and efficiency of North Dakota’s wind resources.

Reviewer 1C (Rating:4)

The proposal is well presented and the objectives are very clearly stated.

- 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: 3)

With the resources and timeline, such an engineering study should be achievable. The only question is one of the geotechnical data collection. I am not well enough informed to understand the time required to deploy equipment and gather data before it is analyzed. The proposers should be asked to provide detail about the process.

Reviewer 1B (Rating: 2)

In that this project is analytical in its approach, the only time constraints should be the efforts dedicated by the various participants. If each participant will devote the time required to complete their portion of the project in a judicious manner, completion can be expected to match the proposed 8 month period. This is a big “if” however and will be largely dependent on the management diligence of the Program Manager.

The statement that the feasibility study will provide the “total value proposition” is probably overstated. It may move the Commission down the road to being able to evaluate BES as a viable option to pursue, but there will certainly be more investigation needed. Much of the value of this project will be to identify what else needs to be known.

Reviewer 1C (Rating: 4)

Based on the expertise of the participants, the objectives should be easily accomplished on time and within the proposed budget.

- 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)

Nothing earth shattering, but the team appears to represent the right combination of talent and expertise.

Reviewer 1B (Rating: 3)

The methodology proposed is appropriate as a first phase for determining the feasibility for BES. Nothing new in techniques for the analysis is apparent in the applications.

CAES studies have the problem of trying to project cost recoveries in a market that is not fully developed in many areas of value. What time period will be used for historic prices for both compression and generation and will that period be a valid basis for future projections? How will market values be set for elements that have no historical position in MISO operations, such as black start, frequency regulation, ramping, load leveling, etc.. Arbitrage between on and off peak operations is not likely to be sufficient to economically justify BES. Will there be rewards for delaying transmission construction? Identifying other value streams and determining how to capture those streams will be required to show an accurate value proposition. It is questioned if a project of this size can include all of these issues.

Reviewer 1C (Rating: 5)

The expertise of EPRI, Schlumberger, and Tetra Tech, and the background of Dakota Salts indicate that performance will be excellent.

- 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)

A significant issue in proposing CAES Bulk Energy Storage sites is a good understanding of the geology (is the geology suitable for storage) and the energy markets (will time –of-generation pricing support the capital and operational costs?) The results of this study should go a long way toward answering those questions and might have a significant impact on how the ND wind resources are developed.

Reviewer 1B (Rating: 3)

This proposal is a necessary first step towards determining the feasibility of CAES in ND. Much additional work will be required to assure that the investment in BES will be justified. The physical work needed to qualify the salt formation as a storage vessel must follow this first step and is likely to be completed only if the financial studies show economic feasibility.

Reviewer 1C (Rating: 3)

The contribution for CAES in salt deposits in ND will be significant for the state. Extending the project to other parts of the state than the Dakota Salts property and to other regions was not addressed, so the overall contribution will await further assessment.

- 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: 2)

I suspect the proposer's awareness of the current research is better than demonstrated, but this proposal is very weak in this area. I discuss this issue in greater detail in my general comments.

Reviewer 1B (Rating: 3)

This project is getting into an application for which there is not a lot of research. Two operating BES plants in the world have proven to be successful for the purpose for which they were built, but this proposal is for a new purpose, mainly commercial generation using available grid markets. Interest in this type of facility is growing in many parts of the United States and worldwide, but until one is built and has operating data, most of the justification upon which decisions to proceed are based must come from research and literature that is not based on real life experiences.

The expertise of the participants will be the most valuable source of information and data. Their analysis based on the available data, using their expertise from related but different experiences will only be ultimately validated when a BES facility is built and operated.

Reviewer 1C (Rating: 3)

No references were provided, so this rating is based on the expertise of the partners, in particular EPRI and Schlumberger.

- 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: 3)

As with the previous area, very little information was supplied. Just one paragraph describing the background of one member of the team. We are left to assume that respected entities like

Schlumberger and EPRI will supply appropriate individuals to support this project. Probably a good assumption.

Reviewer 1B (Rating: 5)

The participants in this application are probably as good as can be assembled at this point in time. It must be recognized that the work from each participant is being done as modeling and analysis of existing data, rather than physical testing of real conditions. Many assumptions will be made that are necessary, but can always be questioned. Specifically, many references in the application are made to the type of procedures that can be used by Schlumberger to identify the characteristics of the salt formation. But all of these procedures require a well to be constructed in which to perform the tests. Well construction is not included in this application, so the actual parameters of the salt formation will not be available. This means many assumptions on the capability of the formation must be used.

Reviewer 1C (Rating: 5)

Partner expertise is known to be exceptional.

- 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)

Reviewer 1B (Rating: 4)

The plan is well written, but could use more detail on the schedule. It might be easy to get behind in deliverables and not know about it until it was too late to correct the deficiencies. Communications look good if they are followed through with so that the Commission can track the progress and make sure the timelines are being followed. It is not clear that the Program Manager has the needed authority to assure compliance with timelines.

Reviewer 1C (Rating: 4)

The plan seems well thought out and achievable.

- 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: 5)

Reviewer 1B (Rating: 5)

It is not indicated that any equipment will be purchased during this project.

Reviewer 1C (Rating: 5)

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)

Reviewer 1B (Rating: 5)

There is little doubt but that the participants each have facilities and equipment to perform the analysis and modeling needed within their existing companies. This Reviewer has yet to see software that adequately contemplates all the potential benefits of large scale energy storage.

Reviewer 1C (Rating: 5)

Existing solution mining capabilities make this rating high.

10. The proposed budget “value”¹ 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: 4)

Reviewer 1B (Rating: 3)

It appears that the budget amount will restrict the high level of deliverables that are promised. Or it may be that this will be a reassembly of mostly already existing information within each participant’s companies. The investigative activities necessary to gather fresh and current data and information for all the parameters discussed in the application is a large undertaking. Many more dollars than being proposed here have been spent on other BES projects to gain the level of information that is suggested in this application. However, this does not mean that the Commission should not start here if they have not done much investigative work previously.

Reviewer 1C (Rating: 3)

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.

10a. 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.

The minimum 50% cash match is demonstrated.

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)

As identified in the DOE landmark report (20% Wind by 2030), there are two significant barriers to high penetration of wind at the national level. One is transmission (getting the power from the wind farms to the load centers) the other is dispatchability (balancing the load and generation in any given balancing area). While the DOE report describes a scenario by which the nation can achieve 20% wind generation without bulk energy storage, it seems clear that any form of energy storage will serve to mitigate the integration issues and enable higher penetrations over time.

While several forms of bulk energy storage have been discussed in recent years, the proposers rightly identify Compressed Air Energy Storage (CAES) and Pumped Hydro (PH) as the only proven technologies on this scale.

It is clear the BES should be an important part of any program to encourage the development of North Dakota's wind resources. However, the economic and technical barriers are significant. Hence, this project to perform a technical and economic feasibility study.

The proposal seems sound with the exception of the consideration of energy extraction. The proposal addresses this issue only in broad strokes on Page 10, pointing out (again correctly) that CAES systems include a combustion turbine, nearly always powered by natural gas. This introduces two troubling components into the system 1) significant fuel cost risk due to the inherent volatility of natural gas prices and 2) a very real carbon footprint. A CAES project with a natural gas-fired turbine is essentially a natural gas power plant in which the compressor section is run by the wind turbines. To be clear, you get significantly more energy per BTU of natural gas than you can with a simple cycle combustion turbine (2 to 3 times), but the natural gas issue cannot be ignored.

Upon re-reading the section of the proposal, it appears that they may be suggested the use of other technology to mitigate this issue, but the section is vague at best.

Overall, I believe the potential benefits of this project outweigh the downside and I would recommend funding this project.

Reviewer 1B (Funding May Be Considered)

The proposal suggests a great deal of valuable analysis will be performed. This Reviewer questions if the depth of the deliverables can match the Expected Results for the budgeted amounts. The recognition of the needs for wind integration is accurate and valid. It is clear that the Commission should have the type of information suggested in the application. If this is a new or little understood concept for the Commission than this is probably a good introduction to the many issues involved in CAES.

It is questionable if the information to be provided will give a clear indication as to the advisability to proceed directly to design, permitting, and construction as suggested. As stated earlier, physical investigation into the suitability of the salt formation will be needed, to be followed by integrating the information into the modeling and analysis deliverables to be provided if this application is approved. It is likely this project will lead to more questions rather than providing comprehensive data upon which to make construction decisions. This is not a reason in itself to deny the application but should be considered in projecting future actions.

If this project is an early investigation into BES by the Commission, it is suggested it be funded. Just don't expect the "final" answers that seem to be indicated in the application.

Reviewer 1C (Fund)