Technical Reviewers' Rating Summary

Proposal Number G-54-02 Application Title Field Study to Determine the Submitted By EERC Request For $9,500,000.00 Total Project Costs $10,000,000.00

Section A. Scoring

Statement	Weighting Factor	G-54-02A	G-54-02B	G-54-02C	Average Weighted Score
1. Objectives	9	**4**	**5**	**4**	**36**
2. Achievability	7	**4**	**3**	**3**	**21**
3. Methodology	8	**5**	**4**	**3**	**32**
4. Contribution	8	**5**	**4**	**4**	**32**
5. Awareness / Background	5	**4**	**4**	**2**	**15**
6. Project Management	3	**4**	**4**	**3**	**9**
7. Equipment / Facilities	2	**3**	**3**	**3**	**6**
8. Value / Industry - Budget	4	**4**	**3**	**3**	**12**
9. Financial Match - Budget	4	**2**	**2**	**3**	**8**
Average Weighted Score		**206**	**188**	**162**	**185**
	Total: 50				**250 possible points**

OVERALL RECOMMENDATION

FUND	**X**	**X**	
FUNDING TO BE CONSIDERED			**X**
DO NOT FUND			

Section B. Ratings and Comments

1. The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Oil and Gas Research Council goals are:

   The objectives of the study were very well outlined in the proposal and demonstrate the need for investigation of salt cavern storage within the state of North Dakota. Completion of this study will shed light on the feasibility of such projects and encourage industry investment in the North Dakota economy.
   - Reviewer: G-54-02A
   - Rating: 4

   The objectives and goals of the project have been clearly defined by both Legislative action, per Senate Bill 2014, and the documentation provided by the EERC, in regard to research into the feasibility of underground storage of hydrocarbons and hydrogen within engineered salt caverns in the Williston Basin portion of North Dakota. Salt beds targeted for evaluation include those within the Pine, Dunham, and Opeche formations.
   - Reviewer: G-54-02B
   - Rating: 5

The proposed project is clearly satisfy the requirements that would justify support by the North Dakota Industrial/Oil and Gas Research Council.
- Reviewer: G-54-02C
- Rating: 4

2. With the approach suggested and time and budget available, the objectives are:

With the proposed time, budget and approach, the objectives are most likely achievable. The largest source of uncertainly will most likely be the drilling and core recovery operations, though EERC and the proposed contractors have extensive experience in these types of projects which should ensure that execution occurs in a timely and cost-effective manner.
- Reviewer: G-54-02A
- Rating: 4

Objectives involve using largely known technologies and equipment. All parties in the project have extensive experience within the Williston Basin. At this point in time, prices and availability for some of the required oilfield equipment, materials, and technologies are good within the region, but could change if market conditions improve for oil and gas drilling and development.
- Reviewer: G-54-02B
- Rating: 3

The drilling and core collection component appears to have locations currently in hand that are not part of the proposal given that these operations are proposed to begin at the point the project starts. Unfortunately, there are no specified targets or locations to help evaluate the timetable more completely. If specific stratigraphic targets and locations are not currently known then then the drilling schedule is likely to require more time to complete than the proposal indicates..
- Reviewer: G-54-02C
- Rating: 3

3. The quality of the methodology displayed in the proposal is:

The quality of methodology displayed in the proposal is of very high caliber and clearly defined. It is necessary to obtain physical cores in prospective storage locations for modeling and design purposes. The results from these methods will be fully able to demonstrate the feasibility of salt cavern storage to industry investors.
- Reviewer: G-54-02A
- Rating: 5

The multi-faceted approach to researching the potential for salt cavern dissolution and storage of hydrocarbons and hydrogen is unprecedented in the North Dakota portion of the Williston Basin. The data produced will greatly facilitate any effort to create the salt caverns. Cross correlation between conventional logs, core analysis, and physical testing will be possible, and will allow calibration of core and log data for extrapolation to other areas. Formation testing may want to include DFIT or micro-fracturing injection falloff testing to measure in situ formation minimum horizontal stress, for calibration of acoustic mechanical properties logs, if not included in the plans. Confining formation minimum horizontal stress determinations, from a DFIT, can also be used to calibrate core strain relaxation testing results. If stress orientation is needed, post open-hole DFIT dipole sonic and or imaging log runs can be used to measure azimuth and dip of the induced fractures. DFIT testing can also determine formation pore pressure and permeability to the formation fluids.
- Reviewer: G-54-02B
- Rating: 4

No comment
- Reviewer: G-54-02C
- Rating: 3

4. The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Oil and Gas Research Council goals will likely be:

   The scientific and technical contribution with respect to OGRC goals is extremely significant. With little exploration having been conducted in the Williston basin in North Dakota concerning salt storage options, this study will be extremely impactful if successful and will accurately demonstrate the capacity for subsurface salt storage. With large sources of hydrocarbons and limited or costly infrastructure related to production from the Bakken/Three Forks Formations, utilization and local processing options will add to the local economy and maximize the production potential in North Dakota.
   - Reviewer: G-54-02A
   - Rating: 5

   The research performed during this project will produce mostly new data that can be used to develop salt caverns, but data about the mechanical properties of the salt deposits will also be useful in better understanding the casing deformation issues, seen in some Williston Basin areas, within these salt bearing formations.
   - Reviewer: G-54-02B
   - Rating: 4

   If successful, this study could answer the question as to whether or not salt caverns could provide North Dakota with a subsurface storage capacity that the state currently does not have.
   - Reviewer: G-54-02C
   - Rating: 4

5. The background of the principal investigator and the 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:

   The background of the principal investigators and awareness of current research is of very high quality. EERC has a demonstrated track record in successfully performing similar types of projects as well as employing a very capable technical staff with the ability to identify and incorporate relevant literature and practices into project execution.
   - Reviewer: G-54-02A
   - Rating: 4

   While salt cavern creation isn't their primary area of expertise, the principle investigator, Steven A Smith,, the EERC, UND Petroleum Engineering department, and Neset Consulting Services are very knowledgeable about the geology of the Williston Basin, the targeted salt formations, and the operational needs of drilling, logging, and coring the test wells. Bakken Midstream Natural Gas, LLC will bring knowledge of the gathering, transportation, processing, and storage of the natural gas, LNG, NGL, and hydrogen gas. A number of the involved parties, including the principle investigator, have already participated in a preliminary evaluation of the potential for salt cavern development and reported to the NDIC Oil and Gas Research Program.
   - Reviewer: G-54-02B
   - Rating: 4

   There are no references cited. In particular, there are no references to the existing inventory of published literature that would provide significant details concerning the stratigraphic and

geographic distribution of the salt units mentioned.
- Reviewer: G-54-02C
- Rating: 2

6. 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:

   The project management plan included within the proposed study contains a very well defined milestone chart, list of contractors and partners as well as a financial plan. Deliverables have a clear timeline for execution and final reporting with the only area of uncertainty being the contractor that will advise on geologic and engineering aspects of cavern development, an important position.
   - Reviewer: G-54-02A
   - Rating: 4

   The project management plan, detailing milestones, schedule, financial budgeting, communications, and reporting is very well documented and with the EERC's extensive experience and successful completion of multiple past NDIC OGRP projects, including the preliminary salt cavern project G-040-080, they should have no problem with this program.
   - Reviewer: G-54-02B
   - Rating: 4

   No comment
   - Reviewer: G-54-02C
   - Rating: 3

7. The proposed purchase of equipment and the facilities available is:

   The proposed purchase of equipment and facilities primarily relates to core handling or technical analysis of core for modeling purposes. These expenditures are well justified given the scope and goals of the proposed project.
   - Reviewer: G-54-02A
   - Rating: 3

   All equipment is necessary for the gathering, processing, and testing of core and other data.
   - Reviewer: G-54-02B
   - Rating: 3

   The purchase of new equipment is a small component of the project and is needed.
   - Reviewer: G-54-02C
   - Rating: 3

8. The proposed budget “value”1 relative to the outlined work and the commitment from other sources is of:

   The proposed budget value relative to outlined work and commitment from other sources is notably good. The budget should provide for successful completion of drilling and core recovery along with the additional work to be performed by other contractors.
   - Reviewer: G-54-02A
   - Rating: 4

   Meets the requirement of having a non-state industry partner and is within the Legislature funding for the project. The value to the NDIC OGRP is likely to greatly exceed the cost incurred, as it creates data that would not likely be generated outside the program, and yet necessary to encourage the desired petrochemical and energy storage industry.

- Reviewer: G-54-02B
- Rating: 3

No comment
- Reviewer: G-54-02C
- Rating: 3

9. The “financial commitment”2 from other sources in terms of “match funding” have been identified:

   The financial commitment from other sources in terms of matching funds is relatively poor considering that the $500,000 commitment from Bakken Midstream accounts for only 5% of the entire proposed project budget. Commitment of research funds from other industry participants would help even this match towards the ultimate goal of 50% matching funds as stated by OGRC guidelines.
   - Reviewer: G-54-02A
   - Rating: 2

   The minimum requirement of 50% or more in matching funding requirement of the NDIC OGRP is not met, but the funding of the project is also designated by the North Dakota Legislature for use by the EERC, and simply requires a non-state industry partner by included, which has been satisfied by inclusion of Dakota Midstream, LLC in the project..
   - Reviewer: G-54-02B
   - Rating: 2

   The "matching funds" component is poorly defined. In particular the term "property right acquisition". Does this refer to property in the partners possession that will de donated to the project or does it refer to leasing. Difficult to define the value of this.
   - Reviewer: G-54-02C
   - Rating: 3

   EERC would like to thank the reviewers for your time and effort in reviewing our proposal to investigate the feasibility of developing salt caverns in North Dakota for energy/product storage. Your positive feedback and constructive suggestions will strengthen the work as it proceeds. Regarding the comments pertaining to cost share, EERC worked within the legislatively directed language specifically waiving cost share requirements. As always, EERC will seek input and guidance from knowledgeable subject matter experts during the formulation and conduct of the effort. We would like to thank you again for this opportunity and let you know that we are looking forward to getting started on the investigation.
   - Applicant

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. A commitment of support from industry partners equates to a higher value.

2 “financial commitment” from other sources – A minimum of 50% of the total project must come from other sources to meet the program guidelines. Support less than 50% from Industrial Commission sources should be evaluated as favorable to the application; industry partnerships equates to increased favorability.

General Comments

The Investigation of salt cavern storage feasibility will be of very high value to both the state as well as the local economy if successful. Economic utilization of hydrocarbons such as Bakken/Three Forks natural gas will provide additional revenue to the state in addition to job creation and long term industry establishment in the state of North Dakota. While it would be preferential to have a larger portion of the cost borne by industrial partners, investment from the

OGRC will be a critical catalyst in developing energy storage opportunities with potential revenues and benefits that will exceed the cost of the proposed budget.
- Reviewer: G-54-02A

This is a good program, and necessary to determine the feasibility of salt cavern storage of natural gas, NGL, LNG, and hydrogen gas. This storage technology is necessary for development of a viable petrochemical, EOR, and energy storage industry in North Dakota. Incorporating the UND Petroleum Engineering department in the project also leverages access their world class laboratory, simulation, and testing laboratories, as well.
- Reviewer: G-54-02B

This study is designed to address a significant component of North Dakotas petroleum and industrial gas infrastructure. The idea of constructing subsurface repositories is one possible solution. However, the geologic components location, depth and sealing capacity of adjacent units will need to be thoroughly evaluated.
- Reviewer: G-54-02C