

Technical Reviewers' Rating Summary

Proposal Number Application Title Submitted By
 Request For Total Project Costs

Section A. Scoring

Statement	Weighting Factor	G-45-01-A	G-45-01-B	G-45-01C	Average Weighted Score
1. Objectives	9	4	3	1	18
2. Achievability	7	3	2	3	14
3. Methodology	8	3	2	4	24
4. Contribution	8	4	2	4	24
5. Awareness / Background	5	4	2	2	10
6. Project Management	3	3	3	3	9
7. Equipment / Facilities	2	4	3	3	6
8. Value / Industry - Budget	4	5	3	3	12
9. Financial Match - Budget	4	5	3	4	16
Average Weighted Score		190	122	147	153
	Total: 50				250 possible points

OVERALL RECOMMENDATION

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

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 and goals were laid out well.

- Reviewer: G-45-01-A

- Rating: 4

The objectives are clearly stated. These goals seem reasonably consistent with the NDIC/OGRC goals.

- Reviewer: G-45-01-B

- Rating: 3

No comment

- Reviewer: G-45-01C

- Rating: 1

We are gratified that two of the reviewers seem satisfied with our goals and objectives. We would like to address the poor rating from Reviewer C, but doing so is impossible without knowing the reasons for the rating. Is it possible that the reviewer reversed the rating scale on this review point?

- Applicant

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

Everything seems achievable. However, the use of a peaking plant leads to some concern on reliability and timeliness of completing this project.

- Reviewer: G-45-01-A

- Rating: 3

The project proposes to develop a preliminary design and economic assessment of a chlor-alkali and "valuable materials" production plant. It is a logical first step in evaluating the concept. However, key assumptions and weaknesses in the methodology will challenge the likelihood of achieving the objectives.

- Reviewer: G-45-01-B

- Rating: 2

No comment

- Reviewer: G-45-01C

- Rating: 3

We are open to reviewing and reconsidering the key assumptions with the goal of improving the likelihood of success. We recognize that there are simplifying assumptions and that the scope of this work is primarily technical. It is true that this is the logical first step and other issues must be addressed later, but we believe it is appropriate to spend a smaller amount of resources establishing the technical basis before committing larger resources to all of the other issues. We recognize that the peaking plant will only offer an intermittent supply of thermal energy. This is why we have incorporated an auxiliary boiler. Since submitting our original proposal we have further developed the project for Triple 8 and find that it can still be profitable if all heat is purchased. Another option will be to install a dedicated cogeneration block for this facility. So although our key assumptions will influence the economics, we do not expect them to make our conceptual design uneconomical for chlor-alkali.

- Applicant

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

The methodology was described in an understandable narrative.

- Reviewer: G-45-01-A

- Rating: 3

In their assumptions, the authors state that "It is expected that any liquid waste from an operating facility can be disposed in a Class 2 SWD. No consideration is given to permitting new wells or discussing with NDIC about the disposition of oilfield waste water from which materials have been removed." This is very naive, and may very well be a show stopper. Certainly this is something that MUST be undertaken in a feasibility study. Also, while the authors acknowledge the potential for NORM concentration, they don't offer any insight as to a mitigation plan. The authors suggest that a 50,000 bbl/day is the target size for the facility. They further indicate that delivery of the brines to the hypothetical facility would be via truck. This would equate to more than 300 trucks per day. Further, the attendant storage of such volumes of ultra high TDS brines is challenging unto itself, and prompt disposal via Class II wells minimizes the very environmental risk the authors suggest they'd be reducing. The logistical challenges of this concept are ultimately more daunting than are the technological

ones, which this project seems to only focus on. A high quality study would THOROUGHLY consider these "other" challenges. Another item worthy of legal exploration would be the requirements and ultimate disposition of royalties associated with the extraction and monetization of "valuable" resources in produced waters.

- Reviewer: G-45-01-B

- Rating: 2

No comment

- Reviewer: G-45-01C

- Rating: 4

This work is intended to be the logical first step in developing the project. The other challenges identified are not our primary focus at this stage; however, they should be addressed in subsequent steps. Whether the liquid waste can be disposed in a Class 2 saltwater disposal well (SWD) is a decision that must come from NDIC when a case is officially put before them, but we feel this basis is justifiable at this time. If it is determined that a Class 1 injection well or zero-liquid discharge (ZLD) is instead required, either option can easily be later incorporated into the design with minimal impact to the total installation cost. The facility is intended to be built in a modular fashion with the initial insourcing via truck at a capacity closer to 11,000 bbl/day. We anticipate that a pipeline will be required to achieve the full 50,000 bbl/day capacity. Perhaps that was not sufficiently clear in our proposal. The potential for NORM concentration and possible mitigation strategies is something we intend to determine with this project; we do not have the answer presently. One possible mitigation strategy is simply to accept deliveries of brine only from wells that meet our specific criteria. This project would use a minor fraction of the total brine produced in the region, so availability of suitable brine should not be a problem. Finally, a general comment by Reviewer C considered the suspended solids in produced water and potential recoverable minerals that would drop out with those solids. We need to be clear that the suspended solids are not the target of our chemicals/materials production. The chlor-alkali project concept is the recovery of dissolved solids, notably the high concentration of sodium chloride, to provide the feedstock for hydrochloric acid and caustic production. Again, this work is primarily focused on the technical aspects; we expect that other issues, some still to be identified, will need to be resolved at later phases.

- Applicant

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 production of materials from a waste stream could greatly reduce the shipping of materials into the state. This reduction could lead to in state benefits and future development.

- Reviewer: G-45-01-A

- Rating: 4

No comment

- Reviewer: G-45-01-B

- Rating: 2

No comment

- Reviewer: G-45-01C

- Rating: 4

We agree that the benefits of a chlor-alkali facility to the state are very promising.

- Applicant

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:

Though the sources of reference satisfies the objectives of the project, some of the cited sources were not referenced to appendix B correctly.

- Reviewer: G-45-01-A
- Rating: 4

The authors have done a reasonable job of enumerating the technology aspects of the proposed technology solution. However, more thorough background research regarding the balance of plant and logistical items on the 60,000 bbl/day Veolia/Antero facility in West Virginia would've been very helpful.

- Reviewer: G-45-01-B
- Rating: 2

Evidence that valuable materials are economically recoverable was not in proposal. Suggestion to include this evidence.

- Reviewer: G-45-01C
- Rating: 2

We apologize for any confusion caused by the mislabeled references. The detailed design of the balance of plant (BOP) will be completed during the detailed design phase of the project. Barr Engineering Co. (Barr) has the in-house capability for the BOP design when that time comes. The reference to the Antero facility was made to demonstrate that the technology is well established and commercially available. The Antero operation ultimately does not produce chlor-alkali products. Caustic soda and hydrochloric acid represent the two materials with the most value, and they are economically recoverable. Table 3 in our proposal shows that these two materials have potential revenue in excess of \$700 million. Our proposed work will provide the engineering and other details necessary to develop a cost estimate and pro forma so that a return on investment (ROI) can be calculated. Our work will also establish whether some of the lesser products such as lithium, magnesium, and bromine can be profitably co-extracted.

- Applicant

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:

These items were showed in detail.

- Reviewer: G-45-01-A
- Rating: 3

Please enter a comment.

- Reviewer: G-45-01-B
- Rating: 3

No comment

- Reviewer: G-45-01C
- Rating: 3

We appreciate that Reviewer A found that our project management plan and plan for communications among the investors and subcontractors were shown in detail.

- Applicant

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

This was well documented and understandable.

- Reviewer: G-45-01-A

- Rating: 4

It didn't appear that any equipment was to be purchased.

- Reviewer: G-45-01-B

- Rating: 3

Produced water sources are not defined.

- Reviewer: G-45-01C

- Rating: 3

No equipment will be purchased. The existing facilities at UND and Barr are sufficient for the proposed work. Produced water samples for analysis will be collected from promising sites; little cost for this task is anticipated.

- Applicant

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

Proposed budget "value" was described well and shows a commitment to seeing this project through.

- Reviewer: G-45-01-A

- Rating: 5

No comment

- Reviewer: G-45-01-B

- Rating: 3

In an effort to save costs on salary, you could ask the engineering firm to decrease rates for this specific job.

- Reviewer: G-45-01C

- Rating: 3

Barr has already invested more than \$30K of unrecovered costs in support of this concept in ND. We are committed to seeing this project through, and to the long-term development of a chemicals industry in North Dakota. We regard our rates as fair and competitive.

- Applicant

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

Financial criteria was met.

- Reviewer: G-45-01-A

- Rating: 5

It appears that the NDIC minimum cost share requirements have been achieved.

- Reviewer: G-45-01-B

- Rating: 3

No comment

- Reviewer: G-45-01C

- Rating: 4

We agree with Reviewers A and B that our team has found the required match funding for this project.

- 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

It would have been nice to see how this project would be developed on a large full production scale. Reference citations should reference correct item in appendix B. When making statements that this project would reduce brine spills and that public perception will improve because the waste stream is being utilized are very subjective, item (11) on page 9. Opinion would be to stick to science and objectives and not guarantee an outcome. In the end, this project has a potential to increase a benefit from of a waste stream and make it profitable while having the possibility of lessening environmental impacts . Wish you all the best of luck.

- Reviewer: G-45-01-A

The project is too focused on the technical (treatment) aspects of the concept. A thorough feasibility study would concurrently evaluate legal and logistical hurdles.

- Reviewer: G-45-01-B

The project upside is significant for the state of North Dakota for recycling brine. Prior to committing this large amount of dollars to this effort, can Barr or Triple 8 conduct multiple studies on a number of SWD disposal wells to determine what solids are suspended in the produced water. Nearly all solids are dropped out in the form of tanks bottoms at SWD wells. Those bottoms could be analyzed/characterized for recoverable materials in a dedicated lab. if recoverable materials are present, than move forward with the proposal as it is written.

- Reviewer: G-45-01C