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CRADA FINAL REPORT FOR CRADA010393:

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CRADA Final Report
v2010 Aug 24

Date Nov. 3, 2016

PI Adam Weber

CRADA No. CRADA010393

LBNL Report Number _____

1. Parties: TVN Systems, Inc.
2. Title of the Project: “Improved H₂/Br₂ Flow Batteries”
3. Summary of the specific research and project accomplishments:
The goals were achieved in terms of integrating the various participant flow battery hydrogen catalysts, bromine electrodes, and advanced electrospun membranes. These integrated materials were tested in cells at LBNL with demonstration of increased durability, lower bromine/bromide crossover, and similar performance with lower effective material cost.
4. Deliverables:

Deliverable Achieved	Party (LBNL, Participant, Both)	Delivered to Other Party?
Cell testing results	LBNL	yes
Membrane electrode assembly	TVN	yes
Final and quarterly reports (slides)	Both	yes

5. Identify publications or presentations at conferences directly related to the CRADA?

Papers

- a) Impact of membrane characteristics on the performance and cycling of the Br₂-H₂ redox flow cell, M.C. Tucker, K.T. Cho, F.B. Spingler, A.Z. Weber, G. Lin, Journal of Power Sources, Volume 284, pages 212-221 (2015)
- b) Optimization of Electrode Characteristics for the Br₂/H₂ Redox Flow Cell, M.C. Tucker, K.T. Cho, A.Z. Weber, G. Lin, T.V. Nguyen, Journal of Applied Electrochemistry, Volume 45, pages 11-19 (2015)
- c) Advanced Hydrogen-Bromine Flow Batteries with Improved Efficiency, Durability and Cost, G. Lin, P.Y. Chong, V. Yarlalagadda, T.V. Nguyen, R. J. Wycisk, P. N. Pintauro, M. Bates, S. Mukerjee, M. C. Tucker, and A. Z. Weber, Journal of the Electrochemical Society, Volume 163, pages A5049-A5056 (2016)

Presentations:

- a) IFBF 6/2015: Improving the Durability, Performance, and Cost of the Br₂ – H₂ Redox Flow Cell; Michael C. Tucker, Adam Z. Weber, Guangyu Lin, Pau Ying Chong, Trung V. Nguyen, Venkata Yarlalagadda, Peter N. Pintauro, Ryszard J. Wycisk, Sanjeev Mukerjee, and Michael Bates
- b) ECS 5/2015: Durability and Performance of the Br₂ – H₂ Redox Flow Cell; Michael C. Tucker, Adam Z. Weber, Guangyu Lin, Pau Ying Chong, and Trung Van Nguyen

6. List of Subject Inventions and software developed under the CRADA: N/A

7. A final abstract suitable for public release:
This CRADA is established to jointly develop H₂/Br₂ flow batteries with improved materials sets and understanding between TVN Systems and LBNL. The focus of the activities is the testing and optimization of flow battery components to meet efficiency and power requirements. The proposed work is essentially all experimental where TVN Systems will use their knowledge and expertise in membrane-electrode-assembly (MEA) design and fabrication using novel catalyst and membrane materials and LBNL will use their existing knowledge and expertise in flow-battery cell assembly and testing for performance and durability

8. Benefits to DOE, LBNL, Participant and/or the U.S. economy.
The proposed CRADA is to work on next generation flow batteries using the efficient H₂/Br₂ couple as already examined initially by LBNL under an award from ARPA-E. It is expected that the work in this CRADA will lead to improved materials and devices for this flow battery that will enable an inexpensive grid-scale electrical-energy storage solution. Such solution will benefit everyone by enabling smart, carbon-free grids to exist economically. In addition, this CRADA will help to bolster and employ US citizens in manufacturing and technology jobs related to the development and manufacturing of this technology.

9. Financial Contributions to the CRADA:

DOE Funding to LBNL	\$0
Participant Funding to LBNL	\$160,000
Participant In-Kind Contribution Value	\$167,000
Total of all Contributions	\$327,000