

FLORIDA STATE UNIVERSITY

Planning Grant: High Performance and Low Cost Fuel Cells for Future Vehicles

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Description: The objective of this project is to provide an innovative approach to revolution of current energy storage and conversion technology and greatly leverage FSU position in the strategic important area for sustainable energy. The following tasks are proposed to FSU for funding of the planning grant “High Performance and Low Cost Fuel Cells for Future Vehicles”. The proposed tasks will be performed by Drs. Jim Zheng and Richard Liang at the Department of Electrical and Computer Engineering and Department of Industrial Engineering, respectively. First to demonstrate preliminary results in high performance of energy storage and conversion materials and devices in order to seek outside funding consistent with the vision of IESES. The deliverables will be conference proceedings and journal papers and proposal submissions for additional funding.

Budget: \$15,000

Research Integration (collaboration)

- NCSU and NHMFL on advantage batteries
- Industrial Engineering on fuel cells
- Maxwell Technologies, Inc. and Ionova Technologies, Inc. on supercapacitors
- CAPS on microgrids
- MARTECH on thermoelectric
- Shanghai Institute of Technical Physics on photovoltaic
 - N. Dai, F.Y. Huang, S.L. Wang, X.N. Li, J.P. Zheng (co-PI), and D. Wei, “An International Collaboration Group on Solar Cell Technologies Development”, Sponsor: Chinese Academy of Sciences, Budget: \$877,193 (¥6,000,000 RMB), Project Dates: 4/09-4/14.

Progress Summary

To meet Florida’s renewable energy and greenhouse gas targets, there must be an aggressive sustainable energy plan. A microgrid strategy can provide a solution for meeting Florida’s sustainable energy needs. Microgrids are an amalgam of: loads; distributed generation such as: photovoltaic, wind, fuel cells and other renewable energy sources; distributed energy storage devices which include: stationary (flywheels, ultracapacitors, and batteries) and non-stationary entities such as plug-in hybrid electric and electric vehicles. Possible benefits of microgrids are:

- Reduce the number of system-wide power outages by providing islanding capabilities allowing grids to separate from each other, providing for a more stable and reliable power delivery infrastructure.
- Provide a framework in which non-traditional, low-carbon footprint, energy sources such as: wind, solar, and fuel cells can be easily integrated into the existing power system.
- Provide for intelligent energy management and increased efficiency via high-penetration levels of power electronics and control strategies.
- Provide for streamlined integration of both stationary and non-stationary energy storage devices as well as future energy conversion resources such as: ocean current and tidal.
- Directly address greenhouse gas targets.

To this end, the PI and co-PIs formed a research proposal that was submitted to IESSES and subsequently, after peer review, approved for an award. The PI and co-PIs then put together a team of undergraduate, graduate, post-doctoral associates, and visiting scientists to achieve the outcomes of the statement of work.

CONCLUSIONS

Due to budget cuts at the initial stage of the project, the original \$1M that was awarded was cut to approximately \$719K and additionally the 3rd year of the project was left unfunded. The original set of PIs included Dr. Farukh Alvi who at this initial stage decided to decline participation in the research effort since he could fund the same type of work under FCAAP. Due to this, the portion of the Statement of Work relating to Dr. Alvi's work will not be pursued and essentially does not impact the overall objectives of the project. It is envisioned that, due to importance of solar PV installations that are being proposed in the State of Florida, that a modification to the SOW is in order that will address control, stability, and integration of high levels of penetration of solar PV in existing and new grid topologies. A new student will begin working on this research area starting in the fall semester. Another modification to the SOW was proposed for the work that is responsible by Dr. Mischa Steurer. The original intent was to set up a Power Hardware in the Loop (PHIL) interface for experimental work. However, it is felt that a more important issue is to investigate where and how microgrids might be instantiated in the State of Florida. A student was placed on this research effort, but due to lack of interest and performance was not retained. In the fall semester a new student will start on this effort. It is felt that the burn rate is quite appropriate at the moment for this research award and that at the 6 month mark approximately 50% of the first year allotment has been spent. Of primary importance is the fact that: 1) all graduate students have been fully funded, 2) all support requests for summer support for faculty have been honored, 3) there has been a sufficient amount of travel to present research results and participate in workshops and proposal planning meetings, 4) support for undergraduate researchers has been available and utilized, and 5) stipends for visiting scholars has been made available. However, based on the current burn rate, it may be possible to pick up another visiting scholar, partially fund an additional post-doctoral researcher, and another graduate student starting this fall. This is primarily due to a vacancy created by Dr. Wenxin Liu who is leaving this fall to take an assistant professor position at New Mexico State University. In general the research team is making good progress toward the research goals that were set forth in the original SOW, as evidenced by the level of publications in national and international forums. Additionally, the educational goals are being amply met and the funding is providing opportunities for undergraduate and graduate students to achieve an education in an area that is clearly of national importance. Moreover, the PIs have utilized the knowledge and opportunity provided for by the grant to write additional proposals that if funded will help support the initiatives of IESSES and FSU.