

Power Electronics Review Emerging Technology Fund Quarterly Report III

July 2010-September 2010

Recent Activity

Overview of Project Status to the Denali Commission

On August 17th, 2010 Katherine Keith made a brief presentation to the Denali Commission during a meeting which included ARPA-E Director Arun Majumdar, Senator Begich, AEA Executive Director Steve Haagenson, and numerous other dignitaries. The briefing provided the group with a broad look at what this project was aiming to achieve and what the current progress was to date.

WiDAC Meeting of Advisory Committee

An intensive 3 day web conference was held August 30th – September 2nd, 2010 involving University researchers and the WiDAC Advisory Committee. The meeting was intended to allow the opportunity for industry to provide feedback on the University research work plan. Although this was a preliminary evaluation meeting in preparation for a DOE EPSCoR meeting, time was available to update members on the status of the test bed project funded by the Denali Commission.

DOE EPSCoR Meeting

It is apparent that future plans for the project – building research capacity by more faculty and students, and equipment purchase – require additional funding. The DOE EPSCoR Program Manager, Tim Fitzsimmons, led a team of expert reviewers to UAF to examine the work plans pertaining to wind-diesel development. This was intended to justify the request for additional funding for various research projects that are intended to improve the performance, cost, and sustainability of existing and planned wind-diesel systems in Alaska in order to reduce the amount of diesel fuel used for electric power generation, heating, and transportation.

ACEP used this chance to showcase the ongoing research, funded by the Denali Commission, on high-penetration wind-diesel systems which includes this current work of addressing the technical challenges in the areas of power stability and advanced control technologies. In this dialogue, reviewers were able to make valuable suggestions, which hopefully will culminate in future collaborative efforts.

Power Electronics Review

The report has been completed and a copy sent to the Denali Commission on September 21st, 2010 for initial review. The final edited version shall be available for distribution early October 2010. Highlights of the report include:

1. Wind-diesel generation systems and associated high-penetration issues are discussed in detail, with a focus on defined goals and scope for the project.
2. A literature review is given on the various systems and technology available for diesel-off operation and their suitability for the Arctic climate. The report analyzes converter systems for high penetration diesel-off operation and supplementary devices like energy storage (battery banks, flywheels, condensers, dump loads, etc).
3. Proposed test facility – an outline is rendered for the test bed installation, with a brief background on some of the existing laboratories worldwide having similar test bed facilities. Reference is made to the NREL's Hybrid Power Test Bed in more detail as this serves to provide us with an insight to the installation and operation of high penetration systems, and lessons on what to avoid/what not to do.
4. Test Protocols – this section details the various tests to be conducted as well as the procedures for the trials on the test bed. It covers the systematic performance tests and functional checks/fault diagnostics while analyzing the setup for grid forming functions (voltage and frequency stability). The focus is on the working of the components, viz:
 - a) Inverter effectiveness for operation of the wind turbine simulator for diesel-off mode strategy
 - b) Parallel operation of inverter with the diesel gen-set
 - c) Battery charging/discharge and storage
5. Recommendations for contractual obligations and intellectual property are included, to ensure ACEP has the rights to modify converter control software as well as dissemination of information to various stakeholders and the general public. Future plans for extended research on the ACEP test bed are also highlighted, with emphasis on faculty hire, graduate student research, additional equipment purchase, and leveraging for more funding.

ACEP is also considering sending the report to the WiDAC Advisory Committee and NREL for review/comments that may assist in the eventual layout, installation and test trials.

Project Status

Equipment

A 25% down payment has been made toward purchase of initial equipment from Sustainable Automation, Inc. There was a request to adjust the down payment to cover 40% as per the supplier's terms and conditions, and this matter is being handled internally. The battery bank is ready and shipping for the rest of the equipment is expected in January 2010, however, this is contingent on the installation and working of a similar converter system being developed by the supplier, to be deployed at Kokhanok. The ACEP converter, while being the same as the Kokhanok inverter in terms of rating, will incorporate everything the supplier is learning on that project.

Timeline and Budget

Overall, the project is on schedule and on budget – there have been no major revisions to the scope of the project, and preliminary work is ongoing as planned.

Ongoing and Future Tasks

1. The facility for the test bed at the GVEA Bidwell building has been prepared adequately - potable water, heating/air conditioning, safety equipment etc. As we expect to have streaming data during trials, a local firm is being contracted for internet (+ telephone) connectivity.
2. The design drawing for the test bed configuration will be completed in the next few months; ACEP is still considering the installation contractor (Marsh Creek) for this part of the project.
3. Data collection is ongoing.
4. A mechanical engineering graduate student has been identified for this project and he shall be engaged preliminarily this fall.
5. A flow battery was delivered in September 2010 from Prudent energy for performance testing; though this is a separate project, they shall be housed under the same facility and it is the intention of the research team to conduct advanced storage tests on the hybrid test bed to further gauge the capability of the power electronics for this task.