Wind-Diesel Hybrid Test Bed Emerging Technology Fund Quarterly Report III (2011)

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Overview

The defining theme for this task is development of transformative and efficient energy technologies to address high penetration challenges in Alaska, with a focus on integration of intelligent control systems, power electronics, and advanced storage for overall power quality generation, with the added benefit of reduced diesel consumption. A test bed consisting of a wind-turbine simulator, power converter, battery bank, diesel gensets and load bank is the backbone of this Task; control of these integrated systems is via a supervisory control and data acquisition (SCADA) system that acquires real time data from all parts of the system. The SCADA with the associated controller manage the economic and reliable distribution of the generation sources to the loads and turns off (or on) the diesel generators using specified control algorithms. In this way a number of generation sources can be simulated to distribute power to electric loads and some of the loads can potentially inject electric power back into the grid.

Part of the research on the test bed will be devoted to energy storage systems. Initially the functional operation of the wind-diesel system will incorporate lead acid battery bank (336VDC, 896 Ah nominal capacity). ACEP has been performance testing a 5kW, 20 kWh Prudent Energy Vanadium Redox (VRB) flow battery, and this module is to be integrated with the rest of the test bed components for storage and ancillary services research.

Project Status

Equipment

Q3 saw a significant attainment of some of the milestones for the project. UAF entered into a service contract with Marsh Creek LLC of Anchorage for the latter to provide a conducive environment for commissioning and troubleshooting of the test bed equipment to ensure all components run as required prior to final installation at UAF.

Most of the test modules were in place for staggered commissioning while orders and/or acquisition of supplementary equipment (supervisory controller, diesel gensets, etc) were in progress. The functionality of the test bed system has since been demonstrated where the components are able to ‘see’ each other during dynamic simulations.

The main equipment vendor – Sustainable Automation Inc. – made available the distributed power system models (diesel genset, induction generator wind turbine, grid-forming inverter, battery bank and load bank) to be used for exercises by students undertaking research involving the test bed equipment.

Data Collection

Data collection has been ongoing, and of the Alaska Energy Authority (AEA) has been helpful in assisting with access to operational data of wind-diesel systems from selected projects. There are indications that high resolution data may be obtained to enhance transient studies at the test bed. The ACEP data management team has been busy formatting these data for ease of use and analysis. Q3 saw ACEP try to streamline and coordinate the data management efforts with UAA's ISER (since this is similar to what ISER is doing for the DOE EPSCoR project).

ACEP has been interested in data formats for village power systems including fuel consumption, generation levels for both diesel gen-sets and turbines, costs of installation and O&M, electrical data (voltage, current, power, power factor, etc), thermal and flow rate data (fuel flow rates, etc). The data can be obtained from village generation and load dynamics, and may be categorized as: 1) Utility data; 2) Economic data; and 3) Energy research data. The data is limited due to storage capabilities in the communities and the lack of good remote data collection systems.

The simple bottom line energy cost data is really what is important. How much does the energy cost the end consumer ($/kWh) and what savings ($/year) in fuel displacement can be garnered from the implementation of 1) energy efficiency improvement measures, and 2) introduction of renewable/alternative energy sources that are locally viable in that specific order.

New Lab Facility

The building that will house the test bed lab equipment is nearing completion; the ACEP team has been involved in layout design to ensure the civil works are completed with due regard to expected placement of the modules (with corresponding electrical network/switchgear, exhausters, fuel supply bays, drainage, etc).
It is expected that the test bed system shall be installed by the end of the year. A MS graduate student who is undertaking research on control for distributed generation in high penetration systems will continue with performance trials in accordance with the funding objectives, namely, diesel-off operation in high penetration systems.