Proposed Agreement between California Energy Commission and The Regents of the University of California, San Diego

Title: Renewable Resource Management in a Microgrid
Amount: $1,394,298.00
Term: 30 months
Contact: Jamie Patterson
Committee Meeting: 2/22/2011

Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
09	Electric	ETSI	Grid Security	$300,000	$300,000	$0	0%
09	Electric	ETSI	Smart Grid	$1,796,449	$494,298	$12,801	1%
09	Electric	ETSI	Storage	$1,500,000	$600,000	$0	0%

Recommendation

Approve this agreement with The Regents of the University of California, San Diego for $1,400,000.00. Staff recommends placing this item on the discussion agenda of the Commission Business Meeting.

Issue

This contract will research four separate issues in solar forecasting, distributed energy storage, the observability of the microgrid by the California Independent System Operator (CAISO), and using renewable energy for charging of electric vehicles.

Solar Insolation Forecasting - There is a need for forecasting in 15 minute increments up to an hour for solar generation.

Distributed Energy Storage Systems (DESS) - There is a need to mitigate the intermittency of renewable generation. The intermittency may be mitigaged using energy storage.

Observability of Microgrid Operation The CAISO cannot observe power flow below the transmission level. If the California smart grid is made up of a collection of microgrids on the distribution system, its operation must be monitored by the CAISO.

Renewable Energy Charging of Electric Vehicles - A demonstration is needed to show the feasibility for a Direct Current linked renewable energy chargeport with energy storage.

Background

The University of California at San Diego (UCSD) sits on 1,200-acres that house a 450-building campus, with a daily population of 45,000. To serve this campus, UCSD operates a microgrid that runs two 13.5 MW gas turbines; one 3 MW steam turbine; and a 1.2 MW solar-cell installation that together supply nearly 80% of the campus' annual power.

Our research will take advantage of this existing infrastructure to add better forecasting capability and demonstrate the use of distributed energy storage systems to mitigate the intermittency of renewable generation. Additionally, our research will demonstrate the coupling of vehicle charging with existing Photovoltaics (PV) installations, and provide the CAISO the ability to observe its operations since this microgrid affects the surrounding San Diego Gas & Electric grid system.

In January 2010, U.S. Department of Energy awarded Jan Kleissl and Byron Washom, from UCSD, a $1.9M grant for the Advanced Modeling of High Penetration of PV on the Distribution Feeder, and was co-funded by PIER. A portion of this grant has a non-redundant solar forecasting task solely related to the UCSD microgrid. The proposed project herein is to complement current and pending research by specifically addressing the comparison of different forecasting techniques (numerical weather prediction, satellites, ground data), enhance their accuracy through model output statistics (MOS), and integrate them for the best possible forecasting product across the climate zones and seasons of California.

UCSD is the prime contractor on a $1M Renewable Energy Secure Communities (RESCO) grant for integrating distributed energy resources into its microgrid, and it will hourly reoptimize its generation, storage and load based upon dynamic market price signals. The new research builds upon the RESCO grant by refining the forecast algorithms to achieve subhourly forecasts.

UCSD has entered into letters of commitments with Nissan for ten Fully Electric vehicle (FEV) Leafs, three plug-in hybrid electric vehicle (PHEV), Toyota's, and it is currently negotiating for a Chevrolet Volt to help with the PV chargeport project.

The Integrated Energy Policy Report (IEPR) states that "integrating increased quantities of distributed generation will require California's energy agencies to work together to develop a comprehensive understanding of the importance of distribution system upgrades not just to assure reliability but also to support the cost-effective integration and interoperability of large amounts of distributed energy for both on-site use and wholesale export. Utilities will need to assess where on their systems distributed generation both for on-site use and for export to the grid would be of the greatest value and provide that information to the energy agencies." The ability to add PV integrated storage and advanced PV inverters to the team's portfolio of RD&D shall "identify which operational characteristics have the highest value; what tools, data, and criteria are used to select these locations; and what obstacles exist to deploying specific types of distributed generation". The team subscribes to the IEPR statement that "energy storage continues to be one of the more promising application areas to make renewable generation available when needed."

Proposed Work

This agreement has four research projects.

The forecasting research project will develop a better intra-hour forecast for solar photovoltaics. This will be accomplished through 'Skytracker' devices that monitor cloud movement near large PV installations.

The distributed energy storage systems project will demonstrate an integrated solution that combines PV and electric energy storage to mitigate the intermittency of renewable generation.

The microgrid observability project will provide the CAISO with monitoring capability for microgrids such as UCSD's. A communication link will be installed and established between the CAISO and UCSD to provide full observability of the operation of the microgrid.

The renewable charging of electric vehicle project demonstrates a Direct Current linked chargeport to maximize the use of renewable energy resources and reduce inverter losses.

Justification and Goals

This project "[will develop, and help bring to market] advanced electricity technologies that reduce or eliminate consumption of water or other finite resources, increase use of renewable energy resources, or improve transmission or distribution of electricity generated from renewable energy resources" (Public Resources Code 25620.1.(b)(4)), (Chapter 512, Statues of 2006)).

This project also addresses PRC 25620.1 (b)(1) Advanced transportation technologies that reduce air pollution and greenhouse gas emissions beyond applicable standards, and that benefit electricity and natural gas ratepayers.

This will be accomplished by:

- Providing better intra-hour forecasts for solar photovoltaics. This will be accomplished through 'Skytracker' devices that monitor cloud movement near large PV plants.
- Demonstrating an integrated solution that combines PV and electric energy storage to mitigate the intermittency of renewable generation. The goal of this demonstration is to provide the CAISO with monitoring capability for the large diverse microgrid at UCSD. A communication link will be installed and established between the CAISO and UCSD to provide full observability of the operation of the microgrid.
- Demonstrating a DC linked chargeport that maximizes the use of renewable energy resources and defers capital utility upgrades.