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

Title: High Solar PV Penetration Modeling
Amount: $500,000.00
Term: 44 months
Contact: Hassan Mohammed
Committee Meeting: 5/4/2010

Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
09	Electric	Renewables	ARRA	$940,000	$250,000	$0	0%
10	Electric	Renewables	ARRA	$940,000	$250,000	$0	0%

Recommendation

Approve this agreement with University of California, San Diego for $500,000.00. Staff recommends placing this item on the discussion agenda of the Commission Business Meeting.

Issue

Both state and the federal government are pursuing greater deployment of renewable energy technologies, particularly dispersed photovoltaics (PV). Complications occur with this new, unplanned source of electricity supply on the distribution grid. Of the future grid designs, microgrids are a nearly self sufficient energy infrastructure built to provide superior power quality and reliability, at a lower cost than the utility system, and with a larger fraction of renewable energy resources.

Although examples of high penetration PV on a distribution system exist, there are far too few occurrences and even fewer representative case studies to have a clear and documented understanding of the impacts that high levels of PV will have on the system availability. There is a need to better understand the effects of PV penetration levels on grid operations with respect to different distribution circuit characteristics, (i.e. circuit designs, load, and generation mixes, etc.), for broad acceptance of high-penetration PV levels in distribution systems throughout the country.

Background

The proposed project is a well established academic-commercial-utility research collaboration between UC San Diego (UCSD), Electrical Design System & Analysis (EDSA) Micro Corporation, and San Diego Gas & Electric (SDG&E). Since 2006, UCSD and SDG&E have had a formal research and develpment (R&D) Memorandum of Understanding that includes this project. EDSA was one of UCSD's core subcontractors on its top scoring proposal to the Energy Commission under the Public Opportunity Notice PON-08-011 for American Recovery and Reinvestment Act (ARRA) cost share. This project would be modeling the integration of a diverse set of distributed generation, storage, and demand response.

This project was proposed to the US DOE for funding under the ARRA and was granted an award of $1,750,000 by US DOE under the federal DE-FOA-0000085 for the High Penetration Solar Deployment solicitation. As a part of the total project budget of $2,250,000, the UCSD subumitted a proposal to the Energy Commission funding for $500,000 in cost share. DOE reviewed a number of solar projects and awarded funding for this project.

On June 18, 2009, the Energy Commission released a Grant Solicitation and Application Package PON-08-011entitled "American Recovery and Reinvestment Act of 2009 Cost Share" under the Public Interest Energy Research (PIER) Program. This Grant Solicitation was an offer to provide match funding to the applicants seeking ARRA funding from the federal government under the High Penetration Solar Deployment solicitation mentioned above.

Pursuant to the PON, each proposal was screened for completeness and reviewed by Energy Commission staff in February. Letters of Intent for cost share were issued by the Energy Commission to the successful pre-applicants, who were directed to submit final applications to the Energy Commission. The Energy Commission's Technical Advisory Committee (TAC) reviewed, evaluated, and scored final applications, using the criteria prescribed in the PON's Application Package, including requirement of receipt of an ARRA award from the federal government. Based on the TAC's scores and directions from the RD&D Committee, the proposed matching funding is recommended for this project.

Funding to supplement the ARRA funding was offered by the Energy Commission in PON-08-011 and was approved by the RD&D Committee on July 9, 2009. The Committee directed that individual project awards would be heard again by them for approval. Proposals to DOE were reviewed and scored by Commission staff, and this project was accepted for supplemental funding under PON-08-011.

This work is being coordinated with a Renewable Energy Secure Communities (RESCO) project (PIR-04-043) on the smart grid component of this effort. This smart grid project will serve the UC San Diego campus. The smart grid software used in this grant optimizes energy efficiency and energy storage operations and manages the response of the micro grid to market energy prices on an houlrly basis for the campus. There is no overlap between the two projects, rather they are synergestic. RESCO focuses on the smart grid component, and this project focuses on forcasting and modelling of the PV penetration.

If approved by the Committee, this item will be presented to the full Commission for approval at a Business Meeting.

Proposed Work

The purpose of this project is to significantly advance the needed modeling tools and validate databases of experience from field experiments with high penetration scenarios of PV on a smart microgrid and smart grid utility distribution system. Smart grid represents the greater ability to increase efficiency and reliability, as well as facilitate the integration and dispatch of renewable technologies into the broader grid network. The project will integrate highly sophisticated power analysis software with a network of twelve densely spaced microclimate monitoring systems and hemispherical sky imagers that provide data for one-hour-ahead of PV output forecasts. This will optimize demand/load adjustments based upon dynamic price signals, and help in achieving high solar penetration. Each one of these five elements in

and of themselves represents the leading edge of the current state of the art, but the assemblage of all five within a single microgrid without any additional capital investment is globally unique.

This project will develop advanced modeling tools and electric power control strategies to optimize electric power value and remove or reduce the impact of PV-sourced electricity on existing microgrids and the smart grid. Factors to be modeled and evaluated include monitoring of micro-climate effects and sky imaging systems to enable 1-hour-ahead PV-sourced electric power output forecasting in conjunction with a utility's dynamic price signals.

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 will be accomplished by:
Achieving greater than twenty percent reduction in feeder peak load through the integration of multiple, integrated PV, other distributed generation (DG), electric energy storage, and price driven load management on a feeder within the UCSD owned microgrid.
Demonstrating the capability of Volt-Amps-Reactive (VAr) electric power management - coordinating the DER with existing VAr management/compensation tools.
Developing a strategy and demonstrating of the information integration focused on both security and overall system architecture.
Developing a strategy and demonstrating "self healing? networks through the integration of Feeder Automation System Technologies (FAST) into microgrid operations.
Demonstrating the capability to use automated distribution control to intentionally island customers in response to system problems.
Developing information/tools addressing the impact of multiple DER technologies including:

- Control algorithms for autonomous DER operations/automation that address multiple DER interactions and stability issues.
- Penetration limits of PV on the substation/feeder.