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OCCC "Solar Project"

Brief Technical Description of the Five PV Systems

Background

A total of five photovoltaic (PV) systems are installed at the Orange County Convention Center (OCCC). They are part of a county-led project called the Solar PV Demonstration Facility and Climate Change Education Center, or "Solar Project" for short. This project features a one-megawatt solar array which is the largest rooftop PV system in the southeast U.S. It also includes four smaller systems selected to demonstrate a variety of promising PV technologies. Three of the smaller systems are ground-mounted and include signage for public education purposes.

The solar project also included the construction of a Climate Change Education Center (operated by the Orange County Environmental Protection Division), the development of a statewide marketing program to promote renewable energy and energy efficiency, and an economic development program for central Florida.

Technical assistance for this project was provided by the Florida Solar Energy Center (FSEC); it was partially funded by the Florida Renewable Energy Technologies Grant Program and it was sponsored and partially funded by the Orlando Utilities Commission (OUC). Subsequent to a competitive RFP process, a design/build contract was awarded to Johnson Controls, Inc. for the engineering and installation of the five PV systems, and for the build-out of the 3,000 square-foot education center.

One-Megawatt PV System

The technical specifications in the RFP consisted of several design and performance criteria for the PV systems. For example, the solar modules were required to have a minimum 20-year warranty with a maximum power degradation of 1% per year. For the one-megawatt system, PV modules had to be certified by a nationally accredited test lab, and 10 randomly selected samples had to be tested by FSEC to verify their rated capacity (DC kW). Proposers had to provide a guaranteed minimum energy production (AC kWh) for the first 12 months of operation. Any deficiency in energy production would result in a specified financial penalty. A web-based open-protocol data acquisition system was required to monitor the live energy production data. Also required, was a written roof protection plan, confirming the maintenance of the existing roof warranty (to review the Design Criteria Package, Part E of Step 2 of the RFP, click here).

The one-megawatt system is comprised of 5,808 SolarWorld SW-175 monocrystalline silicon modules rated at 175Wp at STC. The racking system is a UniRac RapidRac hybrid system; partially ballasted and partially mechanically fastened. The one-megawatt system is subdivided into four 250kW arrays that feed into four 250-kW Satcon inverters that then feed into the building electrical distribution system at four main switchboard panels*. The monitoring system is by Fat Spaniel Technologies (click here to view live energy production and environmental data for all 5 PV systems).

Four Experimental/Demonstration Systems

The four experimental PV systems were specified in the RFP to be nominal-10kW in size. Some of the design criteria had to be modified during the project, due to the unavailability of products originally specified. The installed systems are as follows:

System #1 demonstrates thin-film laminate technology using amorphous silicon solar cells encapsulated in a polymer, with an adhesive backing. Some of the advantages of thin-film laminates include low cost modules that are light in weight and that conform well to various surface shapes. These modules also perform well in low-light and high-heat conditions. This 6.12 kW system consists of 45 Uni-Solar PVL-136 modules, 2 SMA SB5000 inverters, and it also has a 10 kWh (48-volt) battery storage system using eight Discover AGM L-16s.

System #2 demonstrates a technology where each solar module has its own micro-inverter. This system is also designed to provide energy production comparisons for multiple mounting angles and directions. Some advantages of using micro-inverters include simplified system design and installation, no module mismatches, and “levelized” energy production. This 10.5 kW system includes 60 SolarWorld SW-175 modules and 60 Enphase M175-24-208-S02 micro-inverters.

System #3 demonstrates bi-facial technology using modules that absorb light energy on both their front and back sides. The primary advantage of bi-facial modules is an increased power output (15-20% higher than single-faced, when appropriately installed above a light color surface). This 10.64 kW system contains 56 Sanyo HIP-190DA3 modules and 2 SMA SB5000 inverters.

System #4 is operational as a PV system, but not yet fully retrofitted. It will demonstrate PV-thermal technology using hot-air modules attached to the PV array. It will also include a heat-recovery plenum and heat exchanger which will recharge a liquid desiccant system, which will ultimately dehumidify the fresh air intake for a large air handling unit (the dehumidified intake air will reduce the amount of electrical energy required to provide building air conditioning). The 11.2 kW PV system includes 64 SolarWorld SW-175 modules and a Solectria PV1 13kW inverter. The add-on thermal components described above will be installed under a separate project.

***Wiring schematic for the one-megawatt system**: Generally, there are 12 modules per string, 12 strings per sub-array, feeding a total of 40 source circuit combiner boxes (the exceptions are that 4 sub-arrays contain 13 strings). The 40 SCCBs are combined in groups of 10, and feed into 4 sub-array combiner boxes which feed into 4 250-kW Satcon inverters. DC from the modules is converted to AC and fed into 4 main switchboard panels to help meet the electrical demand of the building. If the electrical output from any of the 4 inverters is greater than the demand of its associated switchboard panel, the excess is fed into the utility grid (net metering).