IEUA installed a total peak capacity of 3.5 MW of solar PV rays. More than 220,000 gal of water are saved for each hour at the peak capacity.

Saving Rays

The only thing more important to a water and wastewater utility than meeting its monthly permit is having affordable power available to run the facilities that clean and treat the water. Many industry professionals can recall a few years ago when California experienced rolling blackouts and significant price increases for power. Those incidents resulted in some water and wastewater utilities experiencing frequent changeovers to generator power, there and back again.

By Grant Van Hemert & Keene M. Matsuda

Solar power as a reliable, renewable and redundant utility energy source

These rapid and unpredictable changeovers impacted operations: Sometimes the plant was forced to run at less than full capacity. That summer of upsets influenced the way some California water and wastewater agencies view power.

This shift in mindset led Inland Empire Utility Agency (IEUA) to look for a reliable energy source that was renewable and could serve as a redundant source of primary power. IEUA already had maximized the use of engine generators that run off of digester gas, which indeed is one form of renewable energy, but that resource was tapped out.

To satisfy its "three Rs"—reliable, renewable and redundant—IEUA decided to adopt solar power in its facilities. To help with this effort, the agency looked to the California Solar Initiative (CSI), a progressive and ambitious subsidy program that is largely responsible for much of the recent accelerated growth of solar photovoltaic (PV) systems.

IEUA installed a total peak capacity of 3.5 MW of solar PV arrays. To do this, IEUA built a total of five solar PV arrays at its properties. IEUA leased land for the farms to SunPower, developer of solar PV systems, who then designed, installed and began operating the facility and selling AC power to IEUA.

IEUA turned to Black & Veatch to help integrate the AC power from the solar PV arrays into the existing power distribution system at each plant. The agency's agreement is to buy all of the power generated by the solar PV arrays for a period of 20 years, with an option to buy the facility after that point. The price supplied by SunPower is fixed with a predefined escalation scale, which helps hedge the effects of price swings by its local power utility. The fixed price structure allows IEUA to have a managed cost structure, and the independent ownership exposed the agency to little risk from the solar facility and eliminated maintenance costs. IEUA wanted the project done very quickly, so it transpired in the fourth quarter of 2008.

The solar capacity is separated into five distinct locations: the Carbon Canyon Water Reclamation Facility, Composting Facility, Reclamation Plant No. 5 and two arrays at Reclamation Plant No. 1.

Carbon Canyon Water Reclamation Facility

Carbon Canyon is an 11.4-million-gal-per-day (mgd) wastewater treatment facility. The solar PV array consists of ground-mounted fixed flat panels tilted at 10 degrees from the horizontal for optimum annual energy production. The total peak output rating of 700 kW is installed over an area of approximately 61,000 sq ft. The solar PV array was ground-mounted to a grassy landscaped area within the reclamation facility that was not being used for any other purpose. As such, the integration of this solar PV array did not impact operation of the facility negatively.

Schneider Electric provided two Xantrex GT250 grid tie solar inverters and one GT100 grid tie solar inverter at this location. The 480-VAC, three-phase output of these utility-interactive inverters were combined and fed into a 480-V to 12-kV step-up transformer. The transformer was then interconnected to Carbon Canyon's 12-kV switchgear, which means that the solar-generated power can be used by all the plant loads.

The inverters were connected externally to IEUA's utility power. This connection allowed the inverters to synchronize output with voltage and frequency from the utility. To prevent back-feeding, the inverters will shut down if the external synchronization signal is lost, otherwise known as anti-islanding. This feature conforms to Rule 21, California's interconnection requirements for customer-owned generation.

Composting Facility

Like Carbon Canyon, this solar facility consisted of fixed flat-plate panels tilted 10 degrees from the horizontal. Instead of ground mounting, however, these solar PV modules were mounted on the roof of the composting building. Doing so prevented additional land space from being consumed by the solar production facility. Furthermore, the shade from the solar panels decreases the solar heat loading of the roof.

The solar production is 1.16 MW spread over 170,000 sq ft, divided into three sub-arrays. Sub-Array No. 1 has a total peak output rating of 389 kW; Sub-Array No. 2 has a total peak output rating of 386 kW; and Sub-Array No. 3 has a total peak output rating of 386 kW. Each sub-array has its own inverter.

The composting facility's power distribution system houses two separate electrical rooms, which house the 480-V switchboards and motor control centers, with the 12-kV to 480-V pad-mount transformers located outdoors. The 480-V power distribution system is connected in a main-tie-main configuration via double-bus substation. This configuration divides the facility into four separate zones. Because each of the three solar sub-arrays was small, they were connected directly to the 480-V switchboards and not immediately transformed directly to 12 kV. While this configuration saved on cost and space, it prevented all of the loads in the facility from being powered under solar power at all times.

Reclamation Plant No. 5

Reclamation Plant No. 5 is a 15-mgd treatment facility. The solar PV array uses the same flat-plate modules, but they are affixed to a 20-degree-tilted, one-axis tracking system. This solar PV array has a total peak output rating of 1.2 MW, with the trackers mounted on the ground and arranged throughout approximately 298,000 sq ft.

This system uses the most room of all five solar PV arrays. Part of that is due to the space requirements of the tilted trackers. The rest is to minimize shading effects from the 20-degree tilt from adjacent trackers in the morning and afternoon.

Schneider Electric provided four Xantrex GT250 inverters. Like their counterparts in the Carbon Canyon facility, these inverters are used to tie into the grid. The inverters synchronized with the 60-cycles-per-second frequency and voltage from the utility. This allows for a parallel tie that offsets the purchase of utility power. Likewise, loss of the synchronization signal will shut down the inverters.

Reclamation Plant No. 1

Reclamation Plant No. 1 is a 44-mgd treatment facility. The plant has two solar PV arrays; one is located in a plant area known as Area 5, and the other in that labeled Area 4.

The array in Area 5 consists of a fixed flat-plate module tilted at 10 degrees. Its total peak output is 154 kW over an area of approximately 18,000 sq ft. The facility is unique in that it is mounted on top of the concrete deck of a chlorine contact chamber. This deck was not utilized for any other purpose and presented an ideal mounting location that would not consume valuable real estate. The solar PV array output from Area 5 is connected to Reclamation Plant No. 1's power distribution system via a 480-V switchgear connection in a nearby electrical room.

The PV array located in Area 4 is a flat-plate system that is mounted horizontally on a one-axis tracking system. This mounting is unique in that it is located on pedestals in a large retention basin that is used during overflow or emergency conditions. The equipment is mounted above the expected water line. The total peak power is 779 kW, and the system consumes an area of approximately 130,800 sq ft.

Schneider Electric provided four Xantrex GT 250 solar inverters. As a result, the output was stepped up to 12 kV and then connected to Reclamation Plant No. 1's power distribution system. These inverters, like the other models, have the ability to synchronize with the 60-cycles-per-second frequency and voltage from the utility. Like that of Carbon Canyon, the array is useful for all loads because the output of the solar PV array is interconnected to the plant's 12-kV metal-clad switchgear system.

Green Light

IEUA decided to utilize solar power as a means of hedging against uncontrolled power costs and to increase reliability. A green aspect also exists.

Water quickly is becoming one of the scarcest commodities on the planet. The nation's energy use consumes about 21 gal of water per kilowatt-hour generated. Furthermore, for each watt consumed at water and wastewater utilities, three have to be produced at a traditional power plant.

Thus, for each kilowatt-hour generated by the onsite solar PV arrays, 63 gal of water are saved at a power plant. IEUA has reduced its utility loading by as much as 3.5 MW of power. This means that more than 220,000 gal of water are saved for each hour the agency's solar plants are operating at peak capacity.

Solar and other alternative energy sources can provide water and wastewater utilities a new means of lowering operating costs, enhancing electrical reliability and freeing up valuable water resources. WWD

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