NHA NEWS

Remote Fuel Cell Works for California's Yurok Indians

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This fire lookout tower in Redwood National Park became a telecommunications tower with the addition of photovoltaic panels and a fuel cell. They power radio and telephone service to the Yurok Tribe in the Klamath River Valley in California.

In the summer of 1999, the Yurok Tribe of the Klamath River Valley in rural Northern California decided to provide telelphone service to their residents in remote areas of the reservation using a radio-telephone network. The system would service the tribal health center and offices, with eventual expansion to two schools and 200 residents.

Here at the Schatz Energy Research Center (SERC), we thought the project would be a good opportunity for a remote fuel cell power system. We sought and found private funding and created a base of support within the community. And now the Yurok Tribe of Northern California has access to telephone service.

The SERC/Yurok power system and the telecommunications repeater it supports are located atop Schoolhouse Peak (3,100 ft, 950 m) in Redwood National Park. Because the National Park Service has a ban on fossil fuel stationary power systems within the park, the system had to be clean. Photovoltaic power was the obvious solution, given the site's excellent solar resource during most of the year. The backup power system for the PV? A SERC fuel cell.

The system has accumulated more hours of field operation than any fuel cell we've made or heard of, including those in our cars, which are also out in the field. As of the middle of April 2000, the fuel cell system has run for 2,361 hours. It has been installed for 162 days and has started up 104 times. There have been no shutdowns due to system fault. Gross stack efficiency for the first winter of operation is 64 percent and net system efficiency is 49 percent (both at lower heating value).

The fuel cell system maintains the battery bank state of charge above 50 percent (averaging 74 percent), which will extend battery life significantly, reducing the number of times the system batteries must be replaced and recycled. Eventually (when fuel cells are less expensive), this could entail a significant reduction in the life-cycle cost of photovoltaic systems.

Each day we look at the data, which we access automatically from the lab using a cellular phone. The fuel cell voltage and current, ambient and stack temperatures, and hydrogen storage pressure tell us how well the system is running and allow us to schedule hydrogen deliveries in plenty of time. The system has operated through a rainy Humboldt County winter with only three hydrogen deliveries since its installation in November. As the PV array should carry most of the load during the summer, we expect that four hydrogen deliveries will be sufficient for the entire first year.

The System

The 24-volt PV system consists of 12 Siemens 12-volt, 65-watt photovoltaic modules; 10 Solar Electric Specialties 12-volt, 225 amp-hour deep-cycle batteries; and a Solar Electric Specialties PV Series charge controller/monitor. In accordance with Park Service guidelines, the PV modules are mounted flush on the south-facing wall of an existing fire lookout tower.

The fuel cell is a 32-cell, 140 cm2 PEM stack, designed and fabricated in-house by SERC engineers. The membrane-electrode assemblies are Gore 5510s with E-Tek ELAT gas diffusion media. A solid-state fuel cell controller switches the stack on when the battery voltage falls below 24.7 volts and switches it off when the voltage rises above 25.2 volts. Oxygen is provided to the fuel cell with a small centrifugal air blower. Natural convection cools the stack.

The hydrogen supply for the system consists of 12 industrial gas cylinders manifolded together. Cylinder pressure is initially 2,000 psig, resulting in 60,000 standard liters total storage. Two regulators reduce the line pressure to about 3 psig for delivery to the fuel cell. A commercial supplier delivers replacement cylinders. One day we hope to install a PEM electrolyzer to produce the hydrogen renewably.

The load is a telecommunications repeater transceiver. Continuous power demand is approximately 100 watts DC. Parasitic loads include the fuel cell blower and the hydrogen purge and supply solenoids, totaling an additional 24 watts.

The cost of the system was much higher than the optimistic estimates offered by many in the fuel cell industry. The project included, however, SERC's specialized design, fabrication, assembly, and integration. We applied some new ideas in the field, learning important information about system simplification and durability. We get to track fuel cell behavior under a variety of environmental conditions over a long period of time. At the same time, we are providing a useful (in fact, critical) service in a quiet, nonpolluting way. So, for us, the price was a bargain.

Much must happen between now and fuel cell commercialization: real product development will require large amounts of investment in plant, technological leaps that increase power density and simplify the system, and even government incentives. In the lab we'll need careful research and development, without the promise of immediate gratification. These could take years, but we're holding tightly to our dream of a highly efficient, 100 percent renewable energy economy. The success exhibited in this project is cause for excitement. With each setting of the sun on pristine Schoolhouse Peak, a fuel cell silently engages in service to the Yurok Indians.

Home Page • Return to NHA News Index