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Hydrogen fuel cells for remote arctic villages studied by Sandia and University of Alaska

LIVERMORE, Calif. — In a corner of Sandia National Laboratories' California facility is a collection of hydrogen-powered proton exchange membrane (PEM) fuel cells, perhaps the country's largest collection of these energy devices from different companies.

Fuel cells such as these make electricity and heat by combining hydrogen and oxygen to form water. After initial testing, these particular fuel cells and their associated hardware are destined for the University of Alaska at Fairbanks, where they will be further tested and hardened for Arctic climates for eventual use in remote villages.

The University of Alaska at Fairbanks (UAF) is developing an energy center that will advance the development of efficient and reliable energy systems for arctic environments. Sandia manages hydrogen utilization technical research for the Department of Energy's national hydrogen program, which helps remove technical barriers for hydrogen energy utilization. In the fuel cell project, Sandia is providing technical program management, systems integration and laboratory support. The Alaska Division of Energy is assisting project logistics, site selection and installation. The collaboration is UAF's first project for its new energy center, and is intended to accelerate PEM fuel cell technologies toward commercialization in both arctic settings and more temperate parts of the country.

In remote villages that are not connected by a power grid to a centralized energy supply, electricity is commonly created by diesel generators. As a potential alternative, the researchers envision that utility companies might place fuel cells in homes and operate them in a decentralized fashion. A small network of fuel cells in a village of several dozen or more homes might more flexibly meet demands for heating and lighting.

Diesel generators have set "a fairly high standard for reliability," commented Dennis Witmer, a visiting assistant professor in mechanical engineering at UAF and researcher in the study. He lived in a rural village half a decade. However, he believes a distributed "micro-grid" of fuel cells could efficiently avoid life-threatening risks of losing a central generator during extreme cold spells, as happens occasionally.

"This may be the first application of distributed small fuel cells for electrical power production," adds Jay Keller, the technical program manager who coordinates the project at Sandia's Combustion Research Facility.

Remote arctic villages usually have heating oil tanks at each home. These could also hold diesel fuel to create hydrogen through a reforming process. Waste heat created by this system could be recovered for space heating (which represents about 60 percent of the total household energy demand). However, these technologies must be engineered for frigid conditions, Witmer points out, just as automobiles equipped with special heaters must be plugged into electrical outlets to keep engine oil warm and fluid so cars are not damaged upon starting.

On Sept. 30, Sandia accepted three proton-exchange membrane fuel cells that will be initially tested at Sandia and are destined for systems testing at UAF. The first phase of this program is to develop a fuel cell that will produce 3-5 kW, sufficient average electrical power for a single house, in a laboratory using electrolytic or bottled hydrogen.

By the end of 1998, vendors are due to develop and deliver reformers to convert diesel or kerosene into hydrogen for use in the fuel cell. In the second phase of the program in 1999, reformers will be integrated with the fuel cells. The integrated systems will then be tested as stand-alone laboratory units. In the year 2000, pre-prototype systems are due for field deployment at a remote arctic site.

In addition to helping integrate the reformer technology, Sandia will deliver a novel hydride bed, which can be used to store hydrogen in a non-flammable fashion.

Industrial partners include: Northwest Power Systems (NWP), LLC of Bend, Ore.; Energy Partners of West Palm Beach, Fla.; Plug Power of Latham, N.Y.; Teledyne Brown Engineering - Energy Systems (TBE) of Hunt Valley, Md.; Schatz Energy Research Center of Humboldt State University in Arcata, Calif.; Hydrogen Burner Technology of Long Beach, Calif.

Sandia is a multiprogram DOE laboratory, operated by a subsidiary of Lockheed Martin Corp. With main facilities in Albuquerque, N.M., and Livermore, Calif., Sandia has major research and development responsibilities in national security, energy, and environmental technologies.

Note to editors: Sandia's Keller and UAF's Witmer are available to interview this week at Sandia's Livermore, Calif. facility.

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