

# REMOTE

Site & Equipment Management

April/May 2005

Volume 5, Issue 3

a webcom publication

## Powering Change with Hydrogen Fuel Cells

By Jonathan Dogterom  
Hydrogenics Corporation

Hydrogen fuel cells are providing companies a new alternative for reliable backup power generation and energy storage, in response to the growing needs of telecommunication infrastructure, data centers and other mission critical applications.

Customers that need uninterrupted power for extended periods of time no longer need to struggle with the cumbersome combination of batteries and diesel generators, previously the only option available. Hydrogenics' proprietary Proton Exchange Membrane (PEM) fuel cell technology allows customers to use fully integrated fuel cell power modules that provide high performing power, using hydrogen as a means of energy storage.

In simple terms a fuel cell is a device that converts chemical energy from hydrogen and oxygen into electrical energy to produce an electrical current. PEM fuel cells use hydrogen as fuel and, as the hydrogen moves through a catalyst in the fuel cell, the protons and electrons are split. The electrons are forced to travel through a conductor to the other side of the cell, creating electricity. Depending on the size of a fuel cell, these electrons can be used to do almost anything, from simply lighting a bulb or turning a motor, to powering an entire building block.

When the electrons reconnect with the protons on the other side of the fuel cell they mix with oxygen - the only by-products of the electricity generating process are water and heat. When put to use in a fully operational power module, hydrogen fuel cells produce no noxious emissions and are virtually silent.

PEM fuel cells have long been regarded as a potential replacement for the internal combustion engine of the automotive industry because of its quick ramp up time. While some types of fuel cells take a long time to begin generating their full electricity output, PEM fuel cells begin producing a powerful electric current almost instantaneously, making them ideal for backup power applications.

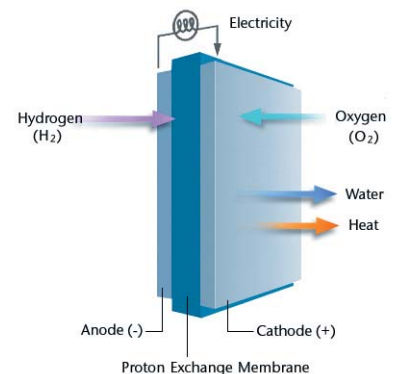
The design philosophy behind the use of fuel cell power mod-

ules for backup power systems extends well beyond its clean and emission free attributes - fuel cells also meet the need for providing a low cost solution that has increased flexibility and reliability, as well as the ability to run for extended periods of time. Unlike diesel generators, the convenience of running a system for a long time is not compromised by the difficulties often associated with diesel systems such as high noise, emissions and the risk of diesel spills. As well, customers are not burdened with high maintenance costs required to ensure that a diesel generator will start up when called upon.

Unlike batteries, fuel cells have several advantages; they do not degrade over time, can operate in a wide range of temperatures, offer higher power densities during extended run times, have less expensive full life cycle costs, do not have safety and disposal issues, and have predictable and limited maintenance requirements. Fuel cells running on hydrogen provide the benefits of batteries and diesel generators without the associated compromises.

Fuel cells provide flexible solutions by enabling the separation of power and energy. A fuel cell will run up to its maximum kW power capacity as long as hydrogen is available. As the load demand at a site grows, an additional fuel cell power module can be added in parallel. Alternatively, if the running time requirements increase, additional hydrogen storage can be supplied to enable the fuel cell to operate for a longer period of time. This versatility has been incorporated into Hydrogenics' current rack mounted HyPM®XR fuel cell power modules, which offer scalable power

### Fuel Cell Operations - PEM



outputs based on 7 and 10 kW modularity, with the ability to build up to 40 kW of power in a single standard 19" server rack.

Hydrogenics has established the reliability of PEM fuel cells by testing its fuel cell systems through thousands of start and stop cycles and thousands of hours of cumulative run time, with negligible system degradation. One key reason why these systems can achieve this kind of reliability is because fuel cells use a chemical process rather than a mechanical means to produce electricity, so therefore have a limited number of moving parts requiring regular maintenance, unlike conventional combustion engines. For this same reason - direct chemical to electrical energy conversion - fuel cells also offer another significant advantage of improved system efficiency. A typical system efficiency of greater than 50% is testimony to the effectiveness of changing chemical energy directly to electrical energy, and avoiding a mechanical by-process.

Backup power systems based on fuel cells are extremely versatile because they can be configured to meet a wide range of technical requirements. For example, in the telecommunications industry fuel cell power modules can be combined with ultra-capacitors (a type of energy storage technology that allows for bursts of power) to provide a fuel cell hybrid power pack. The fuel cell hybrid power pack is capable of delivering an instantaneous response and uninterrupted power and, much like current battery installations; it can "float" on the DC bus and provide continuity with the supply of either 48 or 24 volt DC power.

For systems that demand three phase AC, such as those required in the data centre market, additional power electronics are required to offer complete extended run-time capabilities. Hydrogenics has partnered with a leading UPS OEM to provide a complete fuel cell power system for data centres. In response to the changing needs of the data centre market, Hydrogenics and its UPS partner are working to accelerate the pace of an economical and efficient product that offers increased system availability and backup power runtime.

The use of hydrogen both for energy storage and as a fuel creates additional benefits for adopting fuel cell technology when compared to existing alternatives. Particularly since hydrogen is the lightest and most abundant molecule in the universe and can be generated onsite or delivered by a variety of methods.

A popular hydrogen sourcing option is where industrial gas suppliers transport and deliver hydrogen to point-of-use in standard industrial tanks that are regularly used in a variety of other applications requiring hydrogen.

An alternative method of supplying hydrogen is offered through on-site generation utilizing an electrolyzer, which is capable of generating hydrogen and oxygen by splitting water, using electricity from a primary source such as solar, wind or grid power. The electrolyzer essentially operates in the reverse sequence of a fuel cell.

For example, Hydrogenics' develops several on-site hydrogen fueling options including an electrolyzer based on the Company's proprietary PEM electrolyzer technology. The HyLYZER product is capable of generating hydrogen onsite, as defined by the customers' needs. It can supply hydrogen to a storage vessel and when backup power is required, this hydrogen, that was previously produced, is used in the fuel cell power module. Once power is restored, the electrolyzer subsequently replenishes the storage vessel with a fresh

supply of hydrogen for the next time that backup power is required. This type of system allows a company to have an autonomous, reliable, backup power solution that meets the needs of mission critical applications.

The flexibility, reliability, and cost savings associated with the use of hydrogen fuel cells is generating excitement within the backup power industry and market demand is now beginning to materialize. In 2005 Hydrogenics is launching its backup power program with a telecommunication demonstration involving Bell Canada, alongside twenty-five data centre field trials in partnership with a leading UPS OEM.

As our CEO, Pierre Rivard, often says "the road to the hydrogen economy is not a sprint, it is a marathon" and Hydrogenics is dedicated to helping set the pace of the commercialization of fuel cell technology by targeting premium power markets. The options that hydrogen fuel cells provide for the backup power market are a natural step for this technology and one that is needed.

*Jonathan Dogterom is Business Director, Stationary Fuel Cell Applications at Hydrogenics Corporation. Contact the company at [www.hydrogenics.com](http://www.hydrogenics.com)*

