Methanol Fuel Cells: A New Alternative Energy Source for Remote Applications

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People living along rivers have come to live with the periodic danger of floods. With modern flood-watch technology, this danger finally seemed manageable. Yet, even today there continue to be exceptions. When a 100-year flood inundated an entire region along Germany's River Elbe and its tributaries in 2002, the alert-and-warning systems along the rivers completely failed. What happened?

A very common low-tech problem disabled the latest high-tech systems: they had simply run out of power. In the foul weather solar panels had not been able to collect enough sunlight, forest roads had turned into mud paths and were impassable, so batteries could not be exchanged, and even the grid-powered systems failed when power outages occurred due to downed power lines. Ensuring a 100 percent reliable supply of power to essential off-grid equipment has become one of the most urgent requirements of operators of all kinds of systems for early warning, catastrophe management, security, surveillance and monitoring. As the systems themselves become more refined, precise and useful, their power consumption rises, and the challenges in providing enough power to ensure their uninterrupted operation become more difficult.

Traditional Drawbacks

At the same time, the demand for data collection and real-time monitoring in public and private sectors is continually increasing. Government agencies, corporations and businesses rely on this data for a wide variety of tasks beyond early warning alerts, such as predicting the weather, controlling traffic and assuring the safety and security of people and property.

Until now, operators of off-grid systems had to rely on conventional power supplies like batteries, solar cells or generators. These power supplies, however, all have decisive disadvantages:

• Option one, batteries. Commonly used for powering off-grid applications, they are heavy and contain relatively little power in comparison to their weight. A standard 40-Ah battery will power a 10W consumer device that needs to operate 24 hours a day for just two days. Battery exchange requires frequent and labor-intensive visits by maintenance personnel. These visits, in addition, often are a logistical challenge because the battery exchanges may be required at inconvenient times and the cost required to get the battery to the equipment site may be considerable.

• Option two, solar cells. These systems offer the convenience of no recharging, but their reliance on direct sunlight means they may be inoperable in bad weather, or have limited power during the short days of winter and at critical times. Moreover, solar modules are highly visible and may thus betray the location of the monitoring equipment. This creates an additional challenge for operators of off-grid devices, because solar modules are often stolen, or, in case of security-sensitive applications, disabled by saboteurs.

• Option three, generators. Generators are rarely used in off-grid applications, as they are maintenance-intensive and require regular refills. In addition, they are noisy and produce harmful exhausts which make them unsuitable for use in environmentally protected or wilderness areas.

New Alternative: DMFC for Remote Power

Now operators of off-grid devices have a new power option. Direct Methanol Fuel Cells (DMFCs) provide 100 percent reliable, low-maintenance power to remote-monitoring and data-collection systems. They provide 24/7 power even in extreme weather conditions and can perform for weeks without requiring user-intervention. Once connected to the battery that powers the application, the fuel cell will automatically recharge it as required. The fuel cell is equipped with an automatic charge control that continuously monitors the charge state of the battery. As soon as the voltage drops below a pre-defined level, the fuel cell will automatically switch on and recharge the battery. When the battery is full, these fuel cells automatically return to stand-by mode. With a battery, the fuel cell multiplies the length of time the application can run independently many times over. The fuel cell is completely maintenance free. All the operator needs to do from time to time is exchange the fuel cartridge when the fuel cell signals fuel is running low.

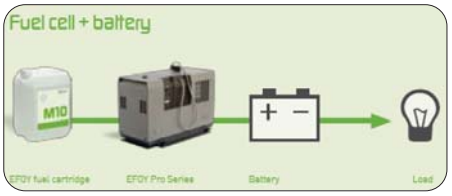

Figure 1: Operation of fuel cell and battery

Fuel cells are particularly efficient because they convert chemical energy directly into electrical energy without any intermediate steps. The essential technical difference between fuel cells and batteries is that fuel cells separate energy transformation and energy storage. The fuel cell will continue to generate electrical current as long as there is fuel.

The energy production process is environmentally friendly. The electrical energy is generated through a noiseless, non-combustion chemical process that transforms methanol and oxygen directly into current and releases only water vapor and carbon dioxide in amounts equivalent to the breath of a child.

Figure 2: EFOY Pro series

High Energy Density, Low Weight, Long Runtime

DMFCs use methanol as fuel to produce electricity. Methanol, a naturally occurring alcohol, is produced industrially from natural gas and, increasingly, from renewable resources such as second generation biomass or even household refuse. It thus helps conserve the planet's resources by producing energy in an environmentally compatible way.

The major benefit of methanol in remote monitoring applications, however, is its extremely high energy density. A comparison: almost 600 lbs. of batteries are needed to provide a capacity of 10 kWh in the field. The same amount of energy is contained in 2.6 gallons methanol, weighing only 17.6 lbs.

In the previous example of the 10 W consumer device, it will run twelve weeks on a cartridge containing 7.4 gallons of methanol. In hybridized applications with solar cells, uninterrupted, service-free runtime will be even longer, depending on available sunlight, because the fuel cell operates only when the solar panel does not produce energy.

A Stand-Alone or Hybrid Solution

Fuel cells can be used as a stand-alone power source or in a hybrid model with solar-power sys-

tems, assuring a continuous supply of energy to the remote monitoring application. In both cases they will supply power to the application's battery. Hybridized with a solar cell they remain in standby mode as long as the solar panel produces power. The fuel cell's integrated charge control automatically starts the fuel cell only when the energy flow from the solar panel stops due to bad weather, darkness or damage of the panel. This ensures that the application will be fully operable even in foul weather.

In addition, hybridizing fuel cell and solar cell systems eliminates the need for having to over-dimension solar panels to ensure they will produce at least a small amount of power in bad weather. In some cases, solar panel areas would have to be four times the size needed in good weather. Thus the complete system overproduced when the sun did shine, but still often failed in bad weather. Batteries, too, would have to be much bigger than actually needed to contain sufficient "emergency storage" before fuel cells enabled hybridization. With fuel cell hybrid solutions, an appropriately sized solar panel or a normal size battery can be combined with an EFOY Pro fuel cell for a reliable power supply to the application. This solution also significantly reduces up-front costs.

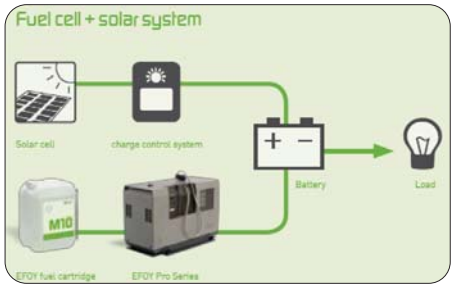

Figure 3: Hybrid operation of fuel cell, solar cell and battery

EFOY Pro Fuel Cells – Proven Technology

The EFOY Pro series by SFC Smart Fuel Cell AG is SFC's solution for the demanding power requirements of operators of off-grid remote monitoring and data-collection systems. They integrate proven fuel cell technology of the company's EFOY series for leisure markets like on-board power for motor homes, sail boats, and holiday and mountain cabins, with added functionalities developed specifically for the requirements of professional applications. They are remote-operable, especially robust with metal casing, maintenance-free, compact and, at a weight of approximately 15 lbs., can be easily transported and installed at almost any location. In operation they are quiet and emission-free and will automatically charge 12-V and 24-V batteries alike: the integrated charge control system will identify the battery in use and will adjust the charge process accordingly.

Fuel Cells in Remote Monitoring/Off–Grid Applications

Fuel cells offer several decisive advantages for operators of off-grid applications:

• **Individualized Power Solution** - Fuel cells are available in three models with charge capacities ranging from 600 to 1,600 Wh per day. Fuel is supplied in three cartridge sizes from 1.3 to 7.4 gallons. By selecting an appropriately sized battery, the power profile of the application and the length of maintenance-free operation can thus be perfectly adjusted to meet individual user requirements.

• **Remote Operable** - Fuel cells can easily be controlled remotely and operated from any mobile phone, laptop or computer. They are available with fuel cartridge sensor and GSM modem.

• **Fuel Cell in a Box** - In applications where the fuel cell will operate in open terrain it is also available as a transportable solution in a configurable box. As such it can be safely left alongside roads or in places with extreme weather and environmental conditions or placed underground for theft protection and for uses where the application is to be hidden from view; e.g., security and surveillance systems.


Figure 4: EFOY ProCube

• **Operation at Extreme Temperatures** - The EFOY Pro fuel cells can be operated in a temperature range from – 31°F to 130°F. They have proven their functionality in the Antarctica winter as well as in Middle East desert climate. EFOY Pro fuel cells are equipped with an integrated frost protection feature which ensures that the fuel cell will not freeze at temperatures below 32°F.

As the German floods and North America's hurricane season remind us, nature periodically will overwhelm our best efforts to prepare for and withstand our best-engineered protections against property loss and human suffering caused by bad weather. But fail-safe remote monitoring and warning systems can help us put up our best defenses against extreme weather as well as provide reliable surveillance and information-gathering for a variety of everyday events. DMFCs assure those systems will do their jobs in any conditions.

Based in Brunnthal, Germany, near Munich, SFC Smart Fuel Cell provides fuel cell technologies for mobile and off-grid power applications serving leisure, industrial, defense and government customers. Founded in 2000, SFC was the first commercial provider of Direct Methanol Fuel Cell (DMFC) systems globally, and today is the only provider of fuel cells to have achieved real revenue from product sales. Unlike most fuel cell manufacturers that are in the research and development phase or who operate subsidized demonstration projects, SFC has shipped nearly 10,000 fully commercial products to end users, and has created a convenient fuel-cartridge supply infrastructure. SFC is DIN ISO 9001:2000 certified. The company's EFOY fuel cell has established its success at providing power for a wide range of off-grid applications by supplying quiet, odorless and entirely automatic power for a variety of demands, personal preferences and power requirements for light electric vehicles (LEVs), sail boats, mobile homes and similar applications calling for off-grid, portable electricity.

Dr. Peter Podesser joined SFC as chief executive officer and chairman of the management board in 2006. He has more than 20 years of experience in international sales and management and has served in a number of executive and senior-management positions at technology companies. These positions include CEO and president of EV Group, and president of Unaxis Wafer Processing Division, where he was responsible for strategic reorientation and restructuring of the division's U.S. and Switzerland divisions. He earned a doctorate degree in strategic planning from the University of Economics and Social Sciences in Vienna.

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