

## Western Water and Power Solution Bulletin

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### Fuel Cell Deployment

*Backup power for direct current (DC) systems at Reclamation hydropower and communications facilities*

#### What Is The Problem?

Reclamation operates 58 hydroelectric powerplants and associated communications facilities throughout the western United States, many of which are in remote locations. Each of these powerplants and microwave communications stations have emergency DC backup power for security, operations, communications, and emergency lighting systems. Prior to 2003, all DC backup power systems were battery powered.

Unfortunately, storage batteries have relatively high maintenance requirements to retain their ability to operate at rated capacity. Delinquent maintenance may result in suboptimal operation or, possibly, failure to operate entirely. In addition, batteries for backup power are costly and often space intensive. Other alternative technologies with lower maintenance requirements such as flywheel and ultracapacitor systems have limited storage capacity making them impractical for even 72 hours of backup service.

#### What Is The Solution?

A hydrogen fuel cell generates electricity through an electrochemical reaction using hydrogen and oxygen. Fuel cells can provide a reliable, low-maintenance solution for providing backup DC power. Monthly test starts can be done remotely and require far less frequent inspection and cleaning than comparable battery backup units. Unlike engine generators, fuel cells have no moving parts, thus demonstrating superior reliability. Fuel cells are modular and easy to replace. Spare fuel cell modules can be stored on site and replaced in a very short period of time – literally within a minute. In addition, modular fuel cells have built-in redundancy so that the failure of one fuel cell does not threaten the ability of the entire backup system to function. The advantages of fuel cells relative to other backup power systems are summarized in the table below.

Backup System	Low Cost	Low Maintenance	Long Run Time	Long Life
Engine Generator	NO	NO	YES	YES
Battery	YES	NO	NO	NO
Flywheel	NO	YES	NO	YES
Ultra Capacitor	YES	YES	NO	YES
Fuel Cell	YES	YES	YES	YES

Importantly, fuel cells have a long life. The fuel cells tested in Reclamation's applications had life expectancies exceeding 10 years. When they do operate, fuel cell run times exceeded battery life by three days to one. And their environmental impact

is relatively benign. Because there is no combustion involved in the fuel cell process, there are no emissions. The only byproduct is water.

#### Who Can Benefit?

All of Reclamation's facilities that use backup DC power systems can benefit from the longer life and reduced costs of fuel cells. Likewise, other non-hydroelectric facilities that have needs for backup DC power may potentially benefit from fuel cell technology, particularly those that are remote or otherwise have difficult or costly maintenance.

#### Where Have We Applied This Solution?

Reclamation installed a fuel cell system at its Pole Hill Powerplant outside of Loveland, CO, replacing the communication system's 48-cell battery system that was at the end of its service life. The fuel cell is designed to deliver 350 watts. Six hydrogen cylinders accompany the fuel cell in an outdoor enclosure. The fuel cell's run time exceeds 72 hours.

Reclamation has performed extensive testing since installation of the Pole Hill fuel cell in October 2003. Some early problems were remedied through collaboration with the manufacturer, ReliOn, and through additional retrofits. For example, problems with cold starts at -6 degrees C were addressed with a heater and additional insulation. Total costs of the fuel cell were estimated at \$31,700 as opposed to \$81,600 for 72 hours of battery backup.

#### Future Development Plans

Reclamation is planning to monitor existing fuel cell systems through FY2008 and consider future sites thereafter. Early results suggest that fuel cells are best applied to communication and monitoring systems rather than powerplant control until a more proven track record is developed.

#### More Information

U.S. Department of Energy, Federal Energy Management Program. *Fuel Cells in Backup Power Applications*.  
[http://www.relion-inc.com/pdf/FEMP\\_FC.pdf](http://www.relion-inc.com/pdf/FEMP_FC.pdf)

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#### Collaborators

Reclamation's Science and Technology Program and Eastern Colorado Area Office and ReliOn  
<http://www.relion-inc.com/default.asp>