



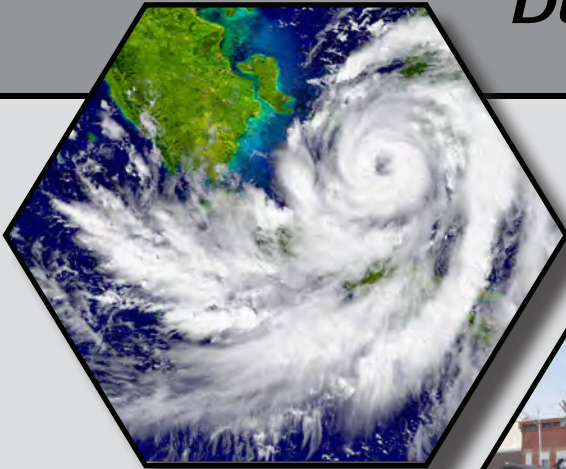
REDHAWK
ENERGY

Innovative Solutions for Your Critical Power Needs

Application Note

Improving Safety at Rail Crossings During Extended Power Outages

Solid Oxide Fuel Cells



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App Note - SOFC for Rail Crossings

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Application Note

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Background

Every year railroads and transit agencies across the United States & Canada experience the wrath of Mother Nature which interrupts the commercial power grid and cripples their signal and communication systems. These extended power outages caused by hurricanes, wind storms, blizzards, ice storms, tornados or other extreme events don't have to jeopardize public safety at rail crossings. While required battery backup at rail crossings can provide 8-10 hours of protection, extended up-time isn't ensured without the use of a supplemental power generating source.

Legacy Technology - Gas/Diesel Generators

For years the conventional approach for providing backup at rail crossings during extreme weather events is the deployment of gas/diesel generators due to their wide power range, mass market availability and low initial cost. What's often overlooked is these gas/diesel generators can be difficult to start due to fuel degradation or lack of routine oil changes/maintenance. The generators that do start require on-going fueling (every 8-10 hours), oil changes every 25-100 hours and are often stolen or siphoned of fuel during times of crisis. Over the past decade rail customers have challenged suppliers like RedHawk Energy to come up with better backup solutions.



Typical gas/diesel generators require refueling intervals of every 8-10 hours to remain operational during times of crisis.

New Technology - Fuel Cells

While Fuel Cell technology has been around since the 1800s, it wasn't until the mid 2000s that economical solutions became available and rail customers began to seriously look at fuel cell technology for backup power at rail crossings and signals. Over the last 15+ years fuel cell technology has continued to evolve and is now used by several railroads for reliable backup power in lieu of gas/diesel generators.

How Fuel Cells Work?

Fuel cells are an electrochemical reaction device that convert fuel and air into electricity without combustion. Fuel cells are DC power generators with no moving parts and are used in conjunction with batteries. There are two major types of fuel cells used for rail applications:

- **Proton Exchange Membrane Fuel Cells (PEM)** - Hydrogen
- **Solid Oxide Fuel Cells (SOFC)** - Propane/Natural Gas



Adaptive Energy (Formerly Ultra-USSI)
P250i Solid Oxide Fuel Cell

For the purposes of this application note we'll focus on Solid Oxide Fuel Cells.



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Solid Oxide Fuel Cells

Solid Oxide Fuel Cells (SOFC) are an eco-friendly alternative to gas/diesel generators and are capable of providing **days, weeks and even months** of reliable, clean, extended-run backup power protection to rail crossings.

Basic Operation

Solid Oxide Fuel Cells (SOFC) work in conjunction with batteries. Powered by readily available, easily transportable and low cost propane or natural gas, a SOFC can sit in standby mode for months to years at a time monitoring battery voltage. When batteries dip below a certain pre-determined lower threshold voltage the SOFC will automatically start and after a brief startup period (25-40 minutes) will charge the batteries and power the load. Once the batteries reach a pre-determined upper threshold voltage the SOFC will automatically begin to cooldown and return to standby mode.

Advantages

Propane or Natural Gas Powered

Solid Oxide Fuel Cells are powered by readily available, easily transportable and low cost propane or natural gas. SOFCs are also very fuel efficient and only consume fuel when called upon.

ZERO Maintenance

Compared to gas/diesel generators that require frequent oil changes and maintenance, SOFCs have no moving parts and need no routine maintenance other than refueling over their life.

Quiet Operation

During operation, SOFCs make about as much noise as a ceiling fan. This also makes SOFCs not as prone to theft like noisy gas/diesel generators.

Eco-Friendly Emissions

Trace emissions of water and carbon dioxide make SOFCs an eco-friendly alternative to cumbersome and dirty gas/diesel generators.

Hot/Cold Temperature Performance

SOFCs utilize a ceramic electrolyte which is not susceptible to freezing and thawing cycles common among PEM style fuel cells. SOFCs robust design allows it to be used in a variety of environments without the need and expense of supplemental heating or cooling.

Long Life Solution

When used as a “backup power source” SOFCs can last many years as they only run when needed and can sit in standby mode indefinitely. Typical SOFC design life is 250 start/stop cycles or 3,000 hours runtime.



Solid Oxide Fuel Cells have no moving parts, need no oil changes or routine maintenance over their life



Solid Oxide Fuel Cells can be easily integrated with existing power infrastructure including solar & wind, batteries, chargers, etc.



Solid Oxide Fuel Cells are powered by readily available, easily transportable and low cost propane or natural gas.

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Proven Deployment

RedHawk Energy is a leader in the development and deployment of Fuel Cells to the rail signaling and communications market. Since 2013, we've deployed several hundred Solid Oxide Fuel Cells to rail customers across the United States and Canada looking for reliable backup power to improve the operation and safety of their rail crossings, signals and related equipment.



Project with major Class I railroad to "harden" mainline track along Gulf Coast



Shortline railroad in upstate Maine wanting to backup remotely located solar crossing



1st SOFC installed with major Class I railroad at busy grade crossing in North Baltimore, OH.

About Us

RedHawk Energy Systems, LLC is a value-added manufacturing subsidiary of the Arthur N. Ulrich Company. Since the early 1980's, we've helped commercial and industrial customers tackle their critical prime and back-up power challenges with innovative solutions ranging from a few watts to several kilowatts. Over the years RedHawk has been a leader in the deployment of advanced energy systems (solar & wind, fuel cells, thermoelectric generators, stirling engines and more) for rail wayside power requirements.

Our customers include virtually every Class 1 railroad in North America, shortline railroads, transit agencies, midstream, upstream and downstream oil & gas companies, telecommunication companies, shipping companies, government agencies, Fortune 500 & 1000 corporations and many others.

Check us out on the web - <http://www.redhawkenergy.net>

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