

# Hydrogen Fuel Cell Applications - Wireless



The emergence of wireless telecommunications as a primary means of communication among the general population and the rollout of 3G network technologies has mandated that network reliability become a top priority. The ability for wireless networks to remain operational in adverse conditions is absolutely critical, affecting life safety E-911 services, revenue and long term customer satisfaction and retention. ReliOn fuel cell solutions offer a key solution to wireless companies actively pursuing initiatives to harden the network against service impacting issues.



**Reli|On**  
+ | -<sup>®</sup>

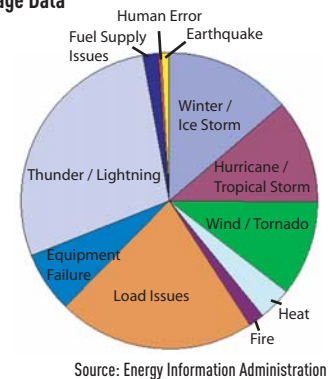
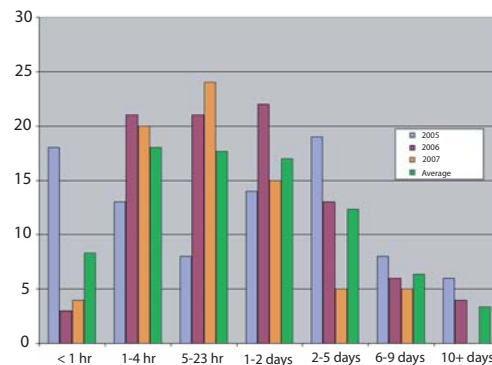
**A New Era in Critical Backup Power**

# Your Sites

The wireless industry faces many challenges today. Billion dollar networks go down due to annual weather events, human issues or natural disasters. Stable service is a necessity for any wireless provider seeking to grow market share and minimize customer churn. Power is a big issue and uptime is critical. Revenue, customer retention, emergency communications – what it comes down to is you’ve got to keep the network up.

Maintaining a robust network is a challenge for all service providers. The wireless market demands quality-of-service; high reliability and 24/7 availability, particularly in severe conditions. Regional and seasonal threats to grid power vary, from hurricanes to tornadoes, ice storms to thunderstorms. According to an average of the 2005 through 2007 data provided by the DOE’s Energy Information Administration, these major disturbances caused more than 128 days of lost grid power per year in the U.S. alone, with durations lasting between minutes and weeks, affecting more than 18 million customers. This does not include the day-to-day disturbances we all experience from time to time. Most of these outages center between one hour and two days in length. The need for “always on” service remains.

2005 -2007 Average U.S. Grid Outage Data



Source: Energy Information Administration

In these situations, backup power becomes key – and finding a solution that works well for all cases is impossible. Even when you have a backup power solution that works fairly well, there can be roadblocks. Redundancy is required to supply consistent power, ensuring an absolute minimum of downtime and stable services by improving reliability and availability. Fuel scarcity in times of disaster can threaten the fuel supply for backup generators, and in some regions, generators themselves become threatened with theft. Additionally, noise and air pollution requirements and spill containment issues can make it difficult to provide power for some sites.

	Cellular/PCS GSM/CDMA/BTS sites	Wireless Broadband BWA, WiMAX, Mesh	Wireless Backhaul Microwave/T1/ Fiber
< 1kW		●	●
2kW	●	●	●
4kW	●	●	
6kW+	●		

At ReliOn, we understand the headaches - with over 100 years experience with communications networks on our management team, many of us have been where you are. We provide backup power solutions for large and small wireless network operators in the United States and in many other world locations - through hurricanes, snowstorms and extreme cold. In applications needing hundreds of Watts as well as those needing several kilowatts – for sites needing hours of backup power and those needing days. ReliOn is there.

ReliOn’s fuel cell solution is forward-thinking, designed with the ability to grow as capacity increases. Modular architecture for power generation and system control enables a cost effective backup solution with a seamless upgrade path. By adding power cartridges or electronics cards, equipment operators are able to leverage initial investments in fuel cell backup systems, balancing capex and opex. With power representing 6% of the cost of a typical cell site (source: PowerWave, April 2005), backing up that power needs to be as cost effective as possible.

## Capacity & Scalability

Wireless operators install systems both indoors and outdoors, depending on the characteristics of the installation site. ReliOn’s fuel cell systems can be installed in a wide variety of configurations, both indoor in standard racks, and in outdoor enclosures. Single systems can be partially populated with power cartridges and electronic cards to meet smaller demands. Multiple units can be tied together to achieve higher capacities. As your needs change, ReliOn’s system can adapt as fast as your power demands require, protecting your investment going forward.

## High Reliability & Availability

ReliOn’s hydrogen fuel cell solution uses industrial-grade hydrogen, available through multiple industrial gas suppliers, yet with little competition for supply during large outages. The fuel cell solution, whether installed indoors or in outdoor enclosures gives no indication that it is a generator, resulting in significantly lower theft.

## Siting and End-Of-Life Management

Many wireless sites are in sensitive areas where noise, emissions, and fuel containment create installation challenges. Fuel spills and old batteries require environmental impact and disposal certificates. ReliOn’s fuel cell systems are quiet, emit no pollutants, have no spillage issues when fueled with bottled hydrogen, and the majority of components can be recovered at the end of its operating life.

# Our Solutions

ReliOn fuel cell systems have revolutionized the application of reliable backup power for critical telecommunications sites. ReliOn's T-1000® and T-2000® fuel cells provide several advantages over traditional backup power methodologies - batteries and internal combustion generators. Fuel cells provide current directly to the DC bus, as required by a telecom network similar to batteries, but have a significantly increased service life and decreased maintenance costs. Additionally, fuel cell runtime, as with a generator, is a function of fuel storage, but with few moving parts and lower maintenance.

## Reliable

- Modular Cartridge Technology® enables selective deactivation of fuel cell cartridges, which adds up to increased reliability of the system.
- Modular, redundant electronics cards improve the dependability of power and interface functions.
- A redundant fan system makes sure that even our one rotating component is ultra-reliable.

## Modular

- Patented modular cartridge design means ReliOn is the only company providing easy hot-swappable maintenance in seconds, without tools, and while continuing to provide power to customer equipment.
- Changing DC voltage output is as simple as swapping a few electronics cards at the customer's site.

## Scalable

The T-series products allow the customer to configure the product to suit the load.

- From under 600 Watts to 12,000 Watts.
- 8 to 96 hours of hydrogen storage.

## Low Maintenance

- Annual air filter inspection.
- Refueling as needed.
- Mean time to repair - minutes.

## Environmentally friendly

- Hydrogen in, power and warm water out.
- Low noise signatures under 60 dBA @ 5 feet.

## Tax Credits Availability

- Federal tax credits through the 2005 Energy Bill.
- \$1,000 per kilowatt or 30% of system cost, whichever is less.
- Additional incentives available in some States.

## Environmentally hardened

- Temperature range from -40°C to 46°C.
- Field-proven ability to perform during hurricanes, ice storms and other harsh weather.

## Monitoring and Control

- Remote / local system configuration and status monitoring for historical and operational data.
- Menu, dry contact, serial port, Ethernet, wireless/wired modems.

	ReliOn	Batteries	Generators
Modular	●	●	●
Scalable	●	●	●
Hot-swappable	●	●	●
Reliable	●	●	●
Simple Design	●	●	●
Environmentally Friendly	●	●	●
Environmentally-hardened	●	●	●
Low Maintenance	●	●	●
Ease of Permitting	●	●	●
Extended Run-time Solutions	●	●	●
Monitoring & Control	●	●	●
Tax Credits	●	●	●

# Specifications



## T-2000® Rack Mount

Physical	21" x 21.5" x 26"
Dimensions (w x d x h)	53cm x 54.6cm x 66 cm
Weight	134 to 244 lbs / 61 to 110 kg
Mounting	23" rack mount
Rated net power	0 to 2,000 Watts
Performance	0 to 80A @ 24VDC / 0 to 40A @ 48VDC
Rated current	24 or 48 VDC nominal
DC voltage	Standard industrial grade hydrogen (99.95%)
Composition	3.5 to 6 psig / 24 to 41 KPag
Supply pressure to unit	0.24 bar to 0.41 bar
Fuel	n/a
Hydrogen Storage Capacity	
Operation	35°F to 115°F / 2°C to 46°C
Ambient temperature	0-95% non-condensing
Relative humidity	-197 ft to 13,800 ft / -60m to 4,206m
Altitude	Indoors
Location	
Emissions	
Water	Max. 30mL / kWh
Noise	55 dBA @ 3.28 ft / 1 meter
Monitoring / Control	
Remote	System configuration & status / Historical & operational data
Communications	RJ45 / DB9 / Dry Contact



## T-2000® 4kW in Enclosure

Physical	54" x 41" x 72"
Dimensions (w x d x h)	137cm x 104cm x 183cm
Weight	1004 lbs / 456 kg*
Rated net power	0 to 4,000 Watts
Performance	0 to 160A @ 24VDC / 0 to 80A @ 48VDC
Rated current	24 or 48 VDC nominal
DC voltage	Standard industrial grade hydrogen (99.95%)
Composition	3.5 to 6 psig / 24 to 41 KPag
Supply pressure to unit	0.24 bar to 0.41 bar

Modular solutions scalable from 48 to 96 kWh

Operation	-40°F to 115°F / -40°C to 46°C
Ambient temperature	0-95% non-condensing
Relative humidity	-197 ft to 13,800 ft / -60m to 4,206m
Altitude	Outdoors



## T-2000® 6kW in Enclosure

Physical	54" x 41" x 92"
Dimensions (w x d x h)	137cm x 104cm x 233.7cm
Weight	1293 lbs / 586 kg*
Rated net power	0 to 6,000 Watts
Performance	0 to 240A @ 24 VDC / 0 to 120A W 48VDC
Rated current	24 or 48 VDC nominal
DC voltage	Standard industrial grade hydrogen (99.95%)
Composition	3.5 to 6 psig / 24 to 41 KPag
Supply pressure to unit	0.24 bar to 0.41 bar

Modular solutions scalable from 48 to 96 kWh

Operation	-40°F to 115°F / -40°C to 46°C
Ambient temperature	0-95% non-condensing
Relative humidity	-197 ft to 13,800 ft / -60m to 4,206m
Altitude	Outdoors



## T-1000® Extended Run

Physical	43" x 35" x 72"
Dimensions (w x d x h)	109cm x 89cm x 183cm
Weight	470 lbs / 212 kg*
Mounting	
Rated net power	0 to 1,200 Watts
Performance	0 to 50A @ 24VDC / 0 to 25A @ 48VDC
Rated current	24 or 48 VDC nominal
DC voltage	
Fuel	Standard industrial grade hydrogen (99.95%)
Composition	3.5 to 6 psig / 24 to 41 KPag
Supply pressure to unit	0.24 bar to 0.41 bar
Hydrogen Storage Capacity	Modular solutions scalable from 48 to 96 kWh
Operation	-40°F to 115°F / -40°C to 46°C
Ambient temperature	0-95% non-condensing
Relative humidity	-197 ft to 13,800 ft / -60m to 4,206m
Altitude	Outdoors
Location	



## T-2000® 8kW in Enclosure

Physical	53.5" x 41" x 72" (per 4kW)
Dimensions (w x d x h)	136cm x 104cm x 183cm
Weight	1,004 lbs / 452 kg* (per 4kW)
Rated net power	0 to 8,000 Watts
Performance	0 to 320A @ 24VDC / 0 to 160A @ 48VDC
Rated current	24 or 48 VDC nominal
DC voltage	
Fuel	Standard industrial grade hydrogen (99.95%)
Composition	3.5 to 6 psig / 24 to 41 KPag
Supply pressure to unit	0.24 bar to 0.41 bar
Hydrogen Storage Capacity	Modular solutions scalable from 48 to 96 kWh

Operation	-40°F to 115°F / -40°C to 46°C
Ambient temperature	0-95% non-condensing
Relative humidity	-197 ft to 13,800 ft / -60m to 4,206m
Altitude	Outdoors

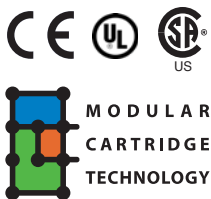


## T-2000® 12kW in Enclosure

Physical	53.5" x 41" x 92" (per 6kW)
Dimensions (w x d x h)	136cm x 104cm x 233.7cm
Weight	1293 lbs / 582 kg* (per 6kW)
Rated net power	0 to 12,000 Watts
Performance	0 to 480A @ 24 VDC / 0 to 240A W 48VDC
Rated current	24 or 48 VDC nominal
DC voltage	
Fuel	Standard industrial grade hydrogen (99.95%)
Composition	3.5 to 6 psig / 24 to 41 KPag
Supply pressure to unit	0.24 bar to 0.41 bar
Hydrogen Storage Capacity	Modular solutions scalable from 48 to 96 kWh

Operation	-40°F to 115°F / -40°C to 46°C
Ambient temperature	0-95% non-condensing
Relative humidity	-197 ft to 13,800 ft / -60m to 4,206m
Altitude	Outdoors

\* weight references fully equipped solutions, without hydrogen cylinders



NEBS Level 3

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6,218,035; 6,387,556; 6,428,918; 6,468,682; 6,773,839  
and other patents pending. Product specifications  
are subject to change at any time.

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