EXTENDED RUN FUEL CELL BACKUP POWER: SOLVING THE HYDROGEN PROBLEM

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NEED FOR EXTENDED RUN BACKUP POWER

Today's telecommunications networks demand backup power solutions that provide highly reliable, cost-effective power for extended periods of time. Proton exchange membrane (PEM) fuel cell systems are proving to be an attractive alternative to traditional and existing solutions such as valve-regulated lead acid (VRLA) batteries and gensets. As fuel cell technologies become a viable solution for industries such as telecommunications, utilities, UPS, etc, the remaining obstacles are hydrogen storage and re-supply for long duration (extended run) backup power requirements. Additionally, at remote installation locations such as telecommunications tower sites, hydrogen can prove to be difficult, bulky and heavy to store, and maintenance to re-supply industrial hydrogen cylinders in these remotes sites is not feasible. Reforming technologies and fuel cell products that incorporate reformers exist today that eliminate these obstacles and pave the way for even broader network applications.

Replacement to VRLA Batteries and Gensets

As can be seen from historical installations, traditional solutions aren't always appropriate for sites requiring extended run times (days vs. hours), and don't always work. VRLA batteries, for instance, are suitable for typical eight hour run times. Generators have significant limitations in that they add to overall backup power system cost and space requirements, they are increasingly difficult to install on-site due to significant noise and emissions, and have high maintenance requirements. Other benefits fuel cell systems have over traditional solutions like VRLA battery strings or gensets include operation in a larger temperature variance, lighter weight, longer life expectancy and greatly reduced maintenance intervals, reduced emissions and hazardous waste, are easily scalable, and have the option for remote monitoring and control.

THE HYDROGEN CHALLENGE

Typical backup power fuel cell systems use pressurized bottled hydrogen which powers the fuel cell stack and produces regulated DC power and clean exhaust and waste heat. Bottled hydrogen is suitable and cost effective for a range of telecom backup requirements, including eight hours or less of backup power time, lower power needs, and where convenient access to hydrogen refuelling is available. Six bottles of hydrogen provide eight hours of backup power for a 5 kW load. However, in situations requiring extended backup power times, higher power needs or in situations where hydrogen delivery is difficult or impossible, compressed hydrogen is a challenge. For example, 36 hydrogen cylinders are required to provide 48 hours of backup power for a 5 kW load.

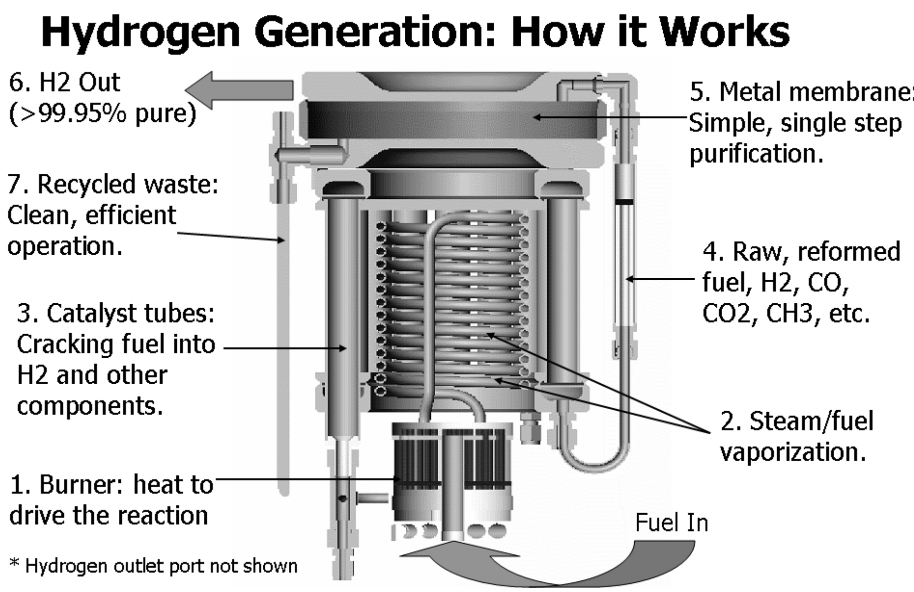
In the comparison between liquid fuel and hydrogen bottles, 60 gallons of a methanol/water fuel mixture and a fuel reformer will provide the same amount of power for the same length of time as 36 hydrogen cylinders. In situations where hydrogen storage is difficult due to space and weight restrictions, the liquid fuel combined with a fuel reformer makes sense.

To successfully provide extended run backup power a system would require the following components:

- a highly efficient, compact fuel reformer
- a sulfur-tolerant fuel purification membrane module with more than 85k hours of testing and operation
- an efficient fuel cell stack/power module based on modular technology

How it Works

To create power, the fuel cell system first activates a burner to drive the reaction, followed by fuel vaporization. Within the catalyst tubes, the fuel is broken into hydrogen molecules and other components. From there, the raw reformed fuel ($H2$, CO, $CO2$, etc.,) is purified by the metal membrane, and the waste elements are recycled in a clean, efficient operation, producing 99.9+% pure hydrogen. The key differentiator in the fuel processing stages is the hydrogen purification method.



Hydrogen Reformation and Purification

Extended Run Reformer

As an example, there are CE-certified liquid-fueled reformers designed to produce hydrogen as needed for extended run times for critical and remote applications. The systems provide virtually unlimited backup power run times when combined with appropriately configured fuel cell systems. This reformer solution is ideal for sites where hydrogen storage is not practical or in remote locations where hydrogen delivery is not feasible.

METHANOL AS A FUEL

The fuel used to operate the extended run fuel reformer, is a fuel mixture of methanol and water. Methanol is a readily available fuel that is currently used in common applications such as windshield washer fluid, engine additives, molded seat cushions, latex paints, clear plastic bottles and silicon sealants, among others. The majority of U.S. methanol production is in Texas, with other plants located in Tennessee and the Midwest. As a fuel, methanol is beneficial as it is easily transported, water miscible, biodegrades quickly and is sulphur-free. Methanol fuel is less flammable than gasoline and burns with a cool, low particulate flame. The fuel is already used as a transportation fuel.

The fuel distribution channel is developing quickly, and the fuel can be ordered and shipped directly from manufacturers as needed in five- and 55-gallon drums. Supply is also available through qualified third party distribution partners. For example, Brenntag is a leading worldwide chemical distributor with operations in North America, Europe, Latin America and South Africa. The North American headquarters are located in Reading, PA, with more than 1200 employees and distribution channels for 5000 products.

Methanol/Hydrogen comparison

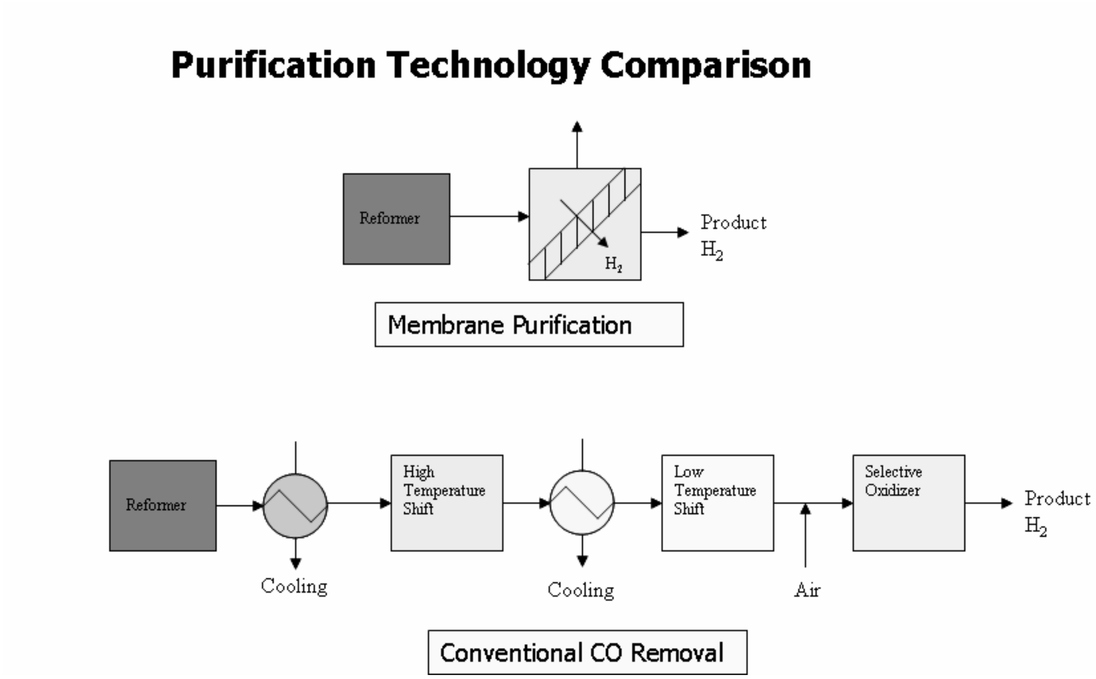
Reforming Technologies are Critical to Fuel Cell Distribution

Reforming technologies enable power generation for a large range of capabilities. Critical backup power or remote power applications where no grid is available now can run for days versus hours of backup power. A sample comparison chart of fuel processing technologies is shown below.

Comparison of Fuel Processing Technologies

Type	Process	Typical Hydrogen Purity (dry basis)
Membrane Enhanced SR	Steam reforming coupled with membrane purifier	>99.95%; <1 ppm CO and <5 ppm CO_2
SR	Steam reforming coupled with conventional CO removal	60 - 75%; 10 - 100 ppm CO and 20 – 30% CO_2
ATR	Partial oxidation coupled with steam reforming and conventional CO removal	40 - 60%; 10 - 100 ppm CO and 20 – 30% CO_2
POX	Partial oxidation coupled with conventional CO removal	25 - 35%; 10 - 100 ppm CO and 20 – 30% CO_2

Membrane purification systems yield a compact, no moving parts solution as compared to other types of fuel reformation processes utilizing heat exchangers and temperature shift reactors.



SUMMARY

In summary, fuel cell backup power systems have numerous advantages versus traditional stand-alone battery or diesel generators. In addition to those benefits, and combating the “hydrogen challenge”, reformer technology solves hydrogen siting issues providing virtually unlimited fuel cell backup power. Existing solutions are commercially available today for mission critical and remote sites. Those fuel cell products for critical power are examples of the range of solutions that can be addressed today using fuel cell and reforming technology.