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# **Company Background and Hydrogen Fueling Capabilities**

## **Hydrogen Workshop September 29, 2009**

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# Proton Energy Systems

- World leader in PEM electrolysis
- Founded in 1996
- All operations located in Wallingford, Connecticut.
- ISO 9001:2000 registered
- Over 1200 systems operating in 58 different countries on all 7 continents.

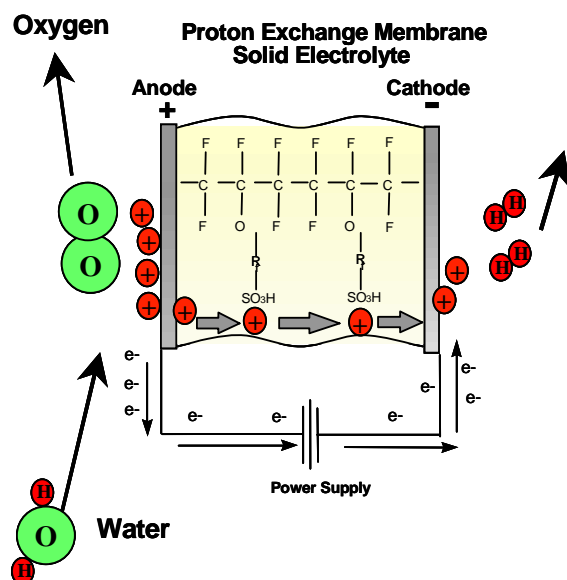


# Development of PEM Electrolysis

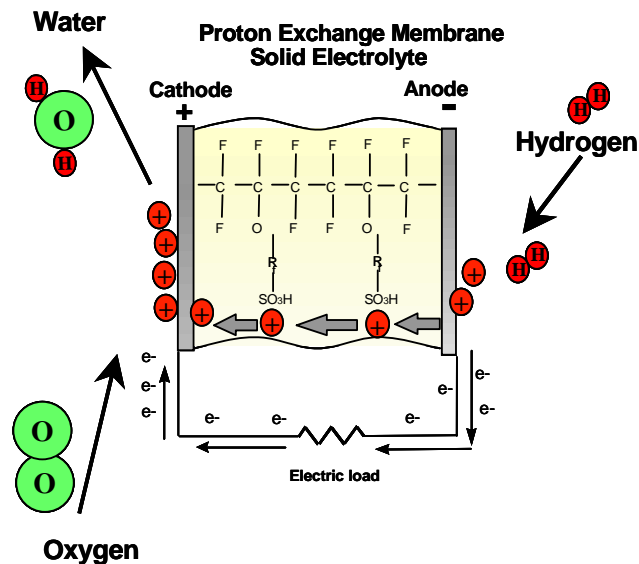


*Initial PEM innovators  
Grubb & Neidrach,  
GE Research, 1955*

**PEM Electrolysis**

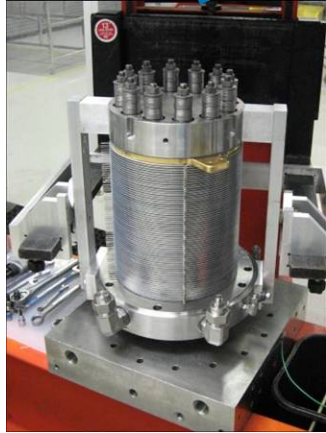


**PEM Fuel Cell**



# PEM Electrolyzer technology has a long history of reliability in mission critical applications:

## SSN and SSBN Submarine Life Support



**Proton cell stack**



**Integrated Low Pressure Electrolyzer**

Photo courtesy of Hamilton Sundstrand



**USS Virginia**

# Proton Capabilities

- Electrolysis System & Cell Stack Development
- Product Manufacturing & Testing
- World-Wide Sales & Service
- Integration of electrolyzers into hydrogen fueling and energy storage systems



**CELL STACK  
MANUFACTURING**






**SYSTEMS  
MANUFACTURING**



**CELL STACK  
R&D**



# Commercial Product Details

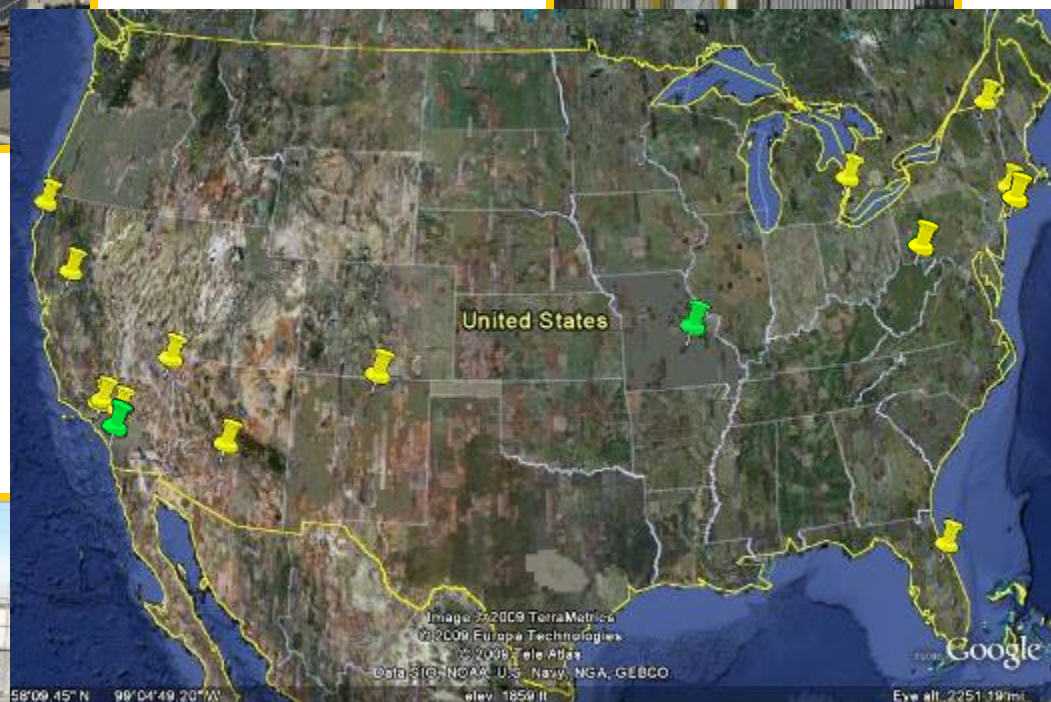
	HOGEN® GC Series	HOGEN® S-Series	HOGEN® H-Series
			
<b>Year Introduced</b>	1999	2000	2004
<b>Applications</b>	Laboratories	Industrial Gas Generation Meteorological Industries Fuelling Industries	Power Plants Heat Treating PCB Industries
<b>Generator Rate</b>	300 or 600 cc/min	0.5 to 1.0 Nm <sup>3</sup> /hr H <sub>2</sub> 1-2 kg/day	2-6 Nm <sup>3</sup> /hr H <sub>2</sub> ; 4-12 kg H <sub>2</sub> /day
<b>Hydrogen Pressure</b>	Pressure to 13 bar	15 bar	15 & 30 bar
<b>Ultra-High Pressure Hydrogen Purity</b>	99.9999+%	99.9995+%	99.9995+%
<b>Dimensions</b>	23 x 37x 52 cm	97 x 79 x 106 cm	200 x 80 x 200 cm
<b>Weight</b>	23 kg	215 kg	700-800 kg

# FuelGen<sup>®</sup> Hydrogen Generation

- Mature
- Proven
- Reliable
- Supported



## Emerging Market: Hydrogen Fueling



### Proton Installations:



Existing



Planned



# Compression, Storage, and Dispensing

- Easily integrated
- Proven track record
- Network of equipment support
- 350 bar and 700 bar options



# What services do we provide?

- Design and manufacture of FuelGen electrolyzers
- Station layout planning and design
- Integration of third party compression, storage, and dispensing
- Interfacing with local authorities during permitting process
- Station requirements definition and refinement
- Equipment installation and commissioning
- System monitoring and maintenance

# E-Vermont Station Burlington, VT



# UNLV Station Las Vegas, NV

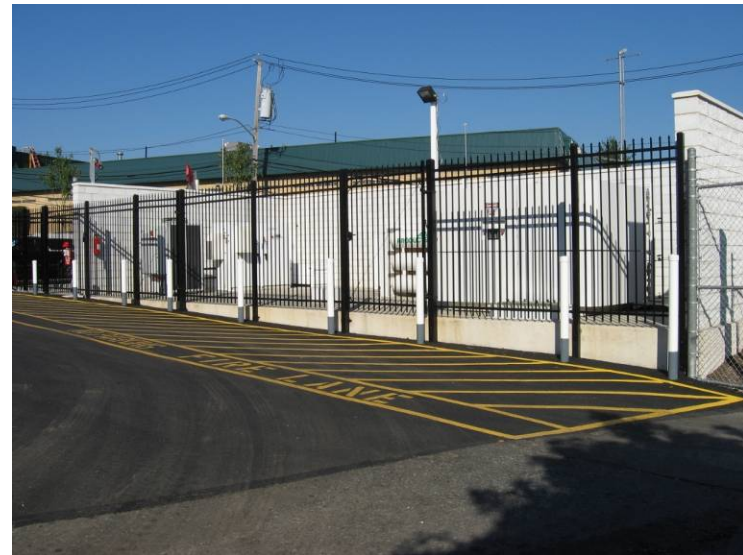


# Yeager Airport Station Charleston, WV





# Shell Station White Plains, NY



# BP / Progress Energy Station Jamestown, FL

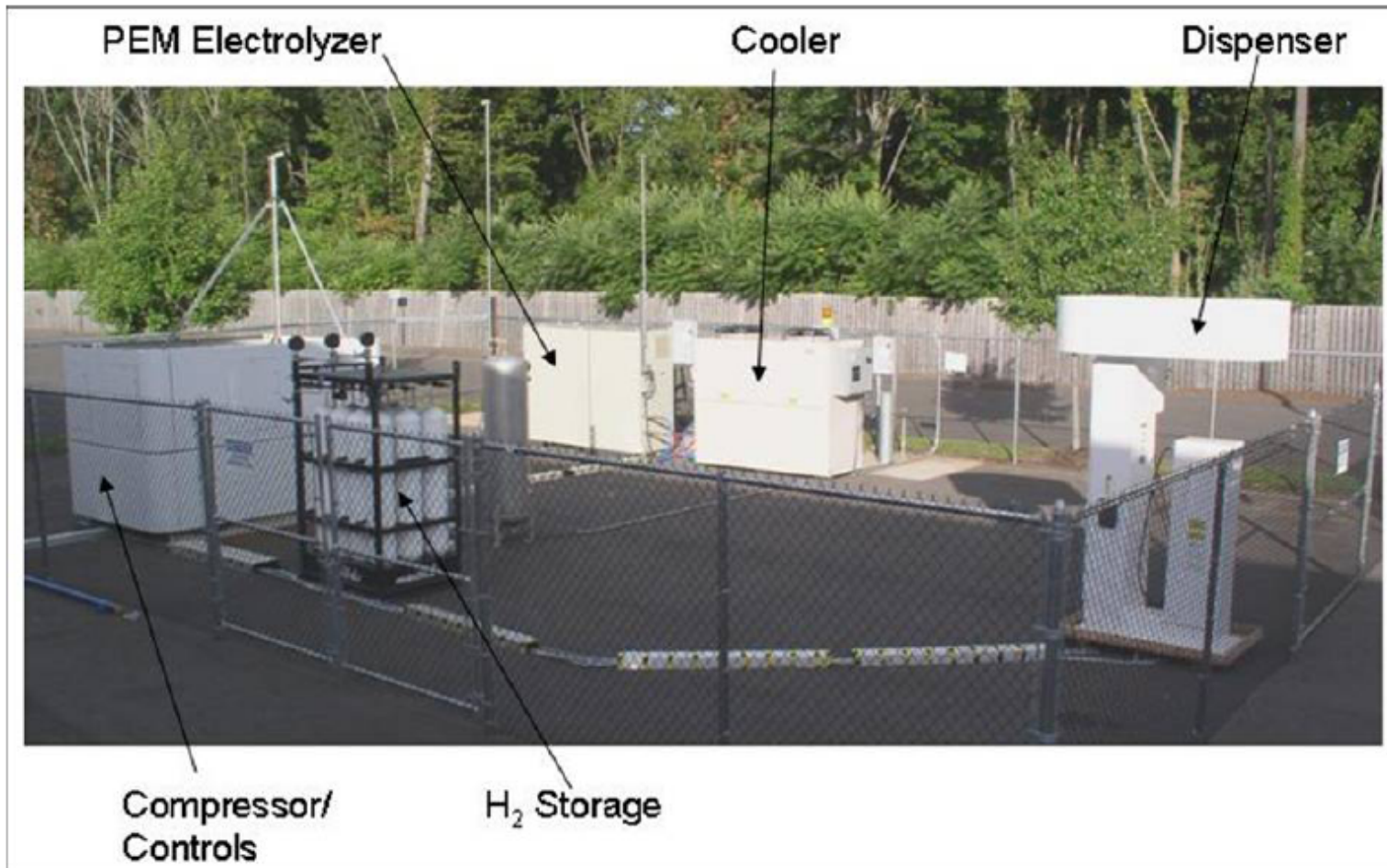


# BP / SMUD Station Sacramento, CA





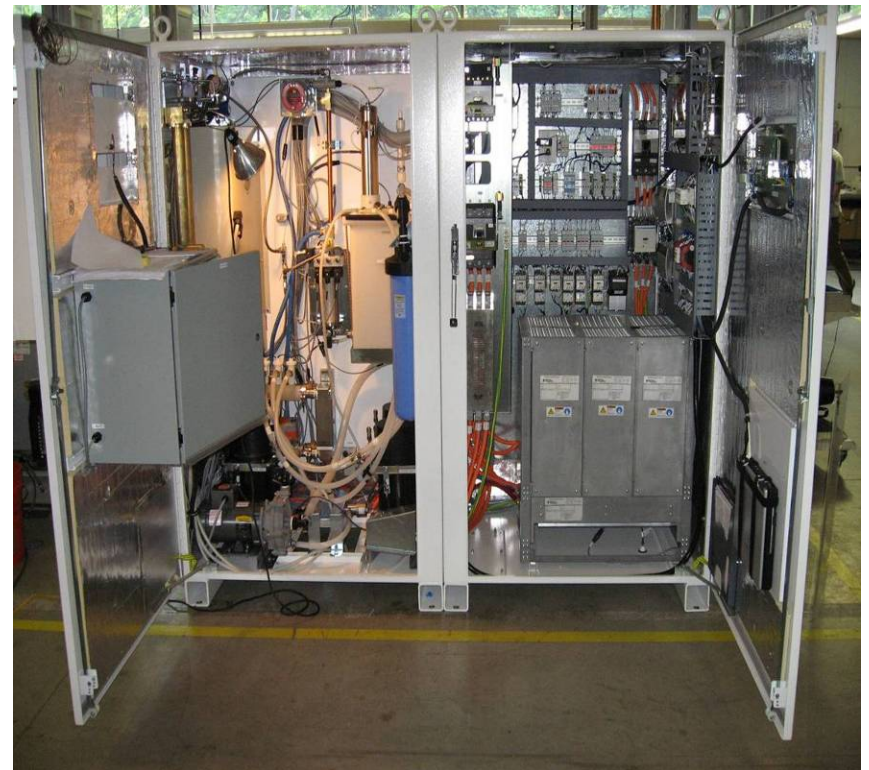
# Typical Equipment Installation



# FuelGen™ Architecture

- Turnkey installation and operation in vehicle fueling applications
- PEM Reliability and Purity
- Outdoor Operation (-25 to 50°C)
- Simple installation and integration with CSD
- Onboard DI water system
- Dew point monitoring

FuelGen™12





# Installation – Simplicity and Small Footprint

(Shell Station – White Plains, NY)



# Commercialization

- PEM electrolyzer cost reduction will follow the maturation of the fuel cell supply chain and reduction of components
- The technical challenges are well in hand and commercialization will grow as fast as the markets emerge
- Government support is critical to the pace at which innovative, cost effective hydrogen infrastructure will be deployed

# Pathways

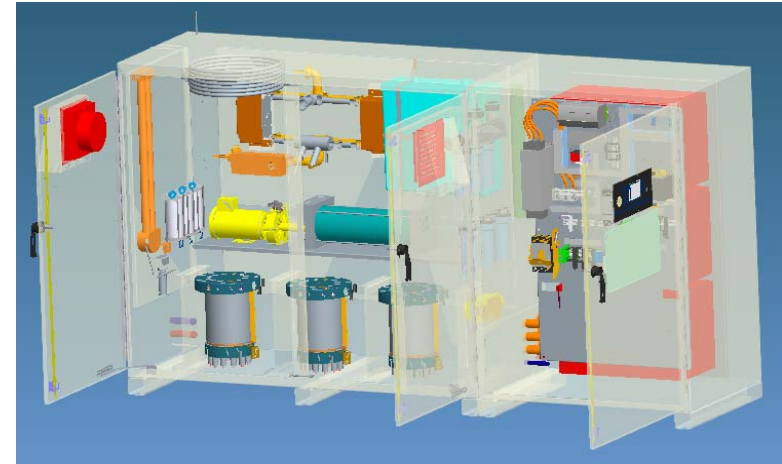
- Traditional fueling station concept based on larger hydrogen production
- Home fueling concept based on smaller production but higher pressure
- Renewable-based hydrogen production viability for both

# Large Electrolyzer Option

- FuelGen™65 Hydrogen Fuel Generator
  - 21 to 65 kilograms per day (10 to 30 Nm<sup>3</sup>/h)
  - 30 bar hydrogen pressure
  - Outdoor installation (-10 to 50°C)
  - Onboard DI water system
  - Dew point monitoring
- Designed to new international standard ISO22734-1

# FuelGen™65 / C Series Architecture

## (Tank Topping / Load Following)



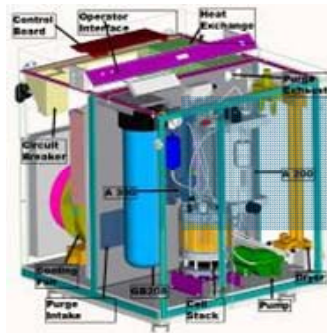


# Home Refueling Product

- 345 bar (5,000 psi) hydrogen production
- Differential pressure design; ambient pressure O<sub>2</sub>
- Up to 1 Nm<sup>3</sup>/h (2.5 kg/day)
- Leverage commercial platform and demonstrated high pressure capability

# Current High Pressure H<sub>2</sub> Generator

- 165 bar (2,400 psi) differential pressure
- 1 Nm<sup>3</sup>/H<sub>2</sub> for Backup Power market
- Field demonstrations underway
- Over 20,000 hrs of continuous operation
- Stack & system durability demonstrated



# How Can CEC and Industry Work Together

- Support funding of hydrogen infrastructure deployment by making the flow of funds simple and expeditious
- Work with industry to find the right sites for deploying fueling infrastructure without bias toward traditional players
- Understand timelines and initiatives for home fueling
- Understand specifications for home fueling from automotive OEMs
- Employ technologies for infrastructure that leverage renewable energy