

Advances in Chemical Hydride Based PEM Fuel Cells for Portable Power Applications

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Who is Millennium Cell?



- The Hydrogen Battery Technology Company
 - ▶ Formed in 1998 and went public in 2000
 - ▶ Ticker symbol “MCEL”, NASDAQ market
- Hydrogen storage and passive PEM systems
 - ▶ **Chemical hydride expertise**
 - ▶ **Recently acquired Gecko Energy Technologies, a passive PEM fuel cell company**
 - ▶ Over 30 patents granted and 74 pending
- Focused on portable applications under 500 watts

Strategic Relationships



- Collaboration to accelerate the commercialization of portable fuel cells



- Portable System Development



- ▶ PEM fuel cell developers and licensees



- ▶ Military development programs

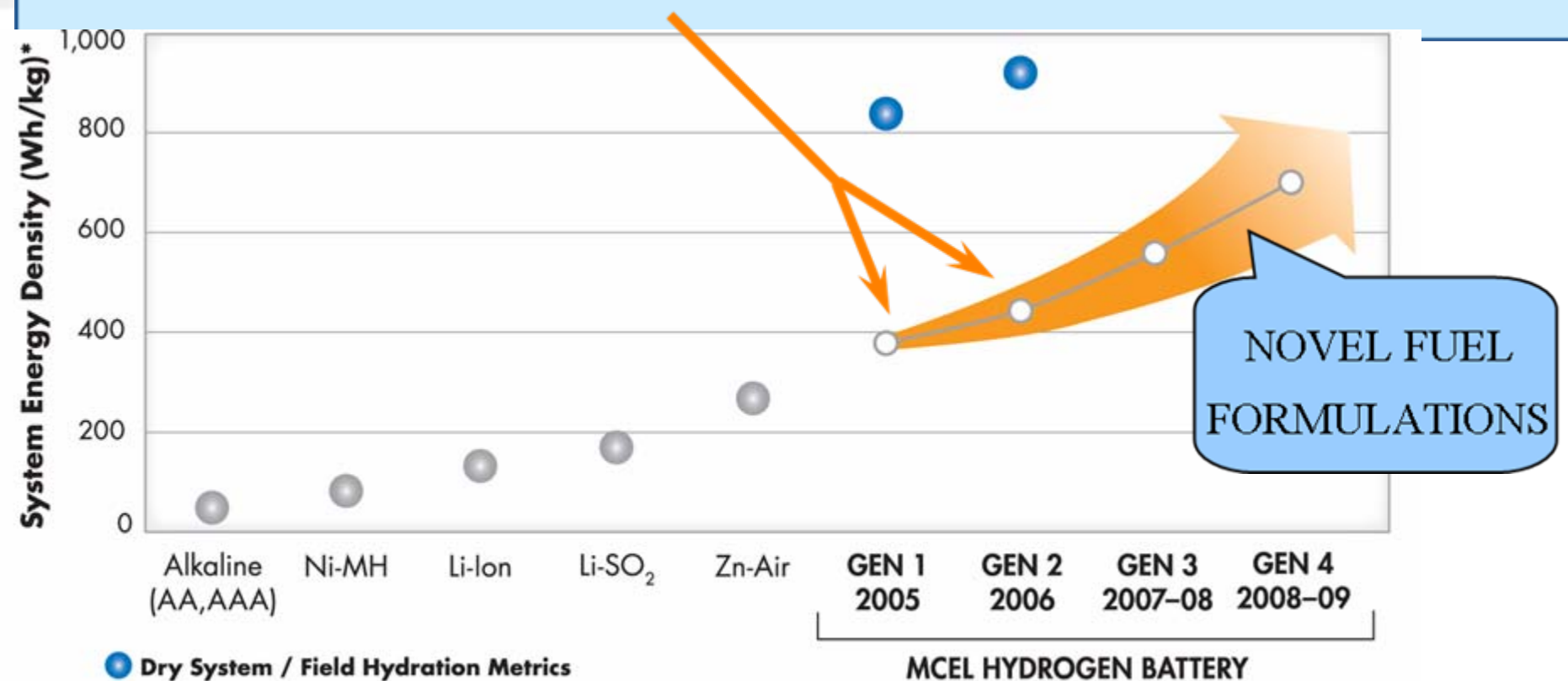
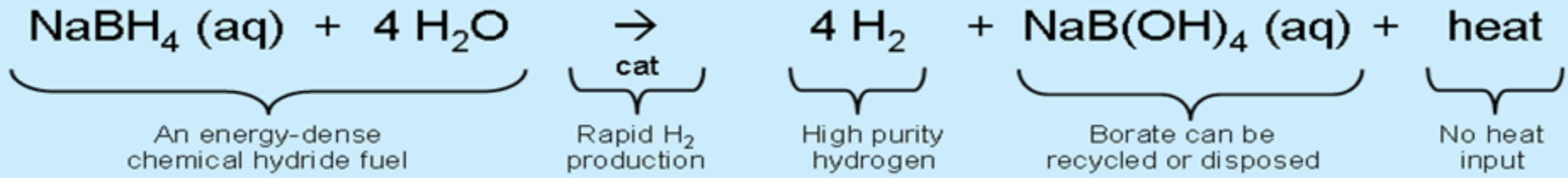


- ▶ Working with non-profit groups



Hydrogen Battery Technology

Hydrogen on Demand® Reaction



*Based on a 30W, 72 hour military mission

Multiple Platforms for Military Applications

■ Sub 20 Watt Passive Platform

- ▶ Long run time wireless sensors
- ▶ Rugged IT

■ 20 – 100 Watt Platform

- ▶ Soldier Power
- ▶ Military Radios

■ 100 – 300 Watt Platform

- ▶ UAV, UGV
- ▶ Battery Charging
- ▶ Medical Evacuation

■ 500 Watt Platform

- ▶ Critical Emergency Power
- ▶ Remote Power

■ High Energy Density Fuel

- ▶ Less Weight
- ▶ Less Volume

■ Safe

■ Indefinite Shelf Life

■ Fuel Gauge

■ Hot Swappable Cartridge

■ Silent Power

■ Low Thermal Signature

Product Development

Passive platform for < 20 W applications

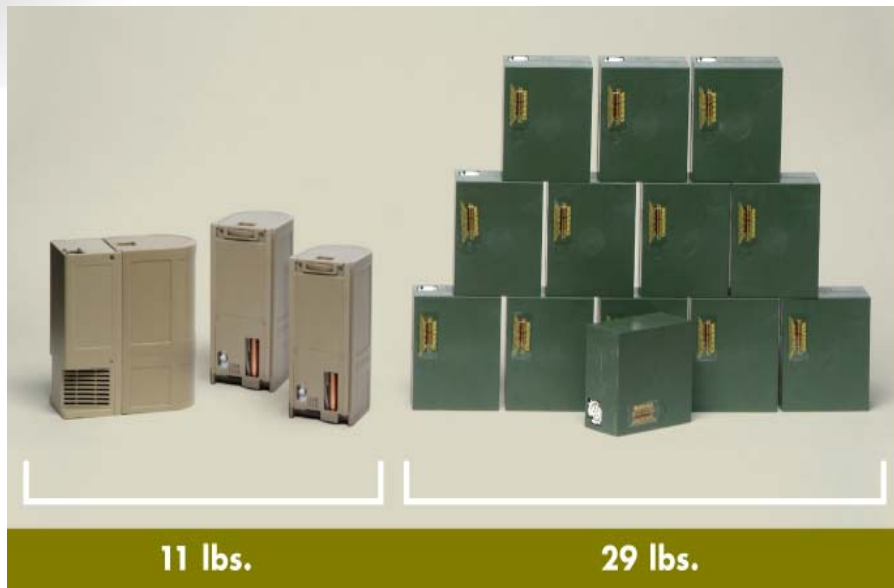
- Initial demonstration system
- Uses Gecko passive PEM fuel cell
 - ▶ High power density → fits in device
 - ▶ High efficiency → lower waste heat
 - ▶ Simple architecture with minimal BOP
 - ▶ Low cost → < \$5 per watt
 - ▶ Thin, flat form factor → no extra volume
- Passive HOD™ system
- Target Applications:
 - ▶ wireless sensors,
 - ▶ handset chargers,
 - ▶ wearable power,
 - ▶ perimeter security

Night Vision Camera



First demonstrated in Sep 2006

30W Soldier Power System



- 30 W x 72 hour mission
- 66 % Lighter than BA 5590
- 20 % Cheaper

150W UAV Power System

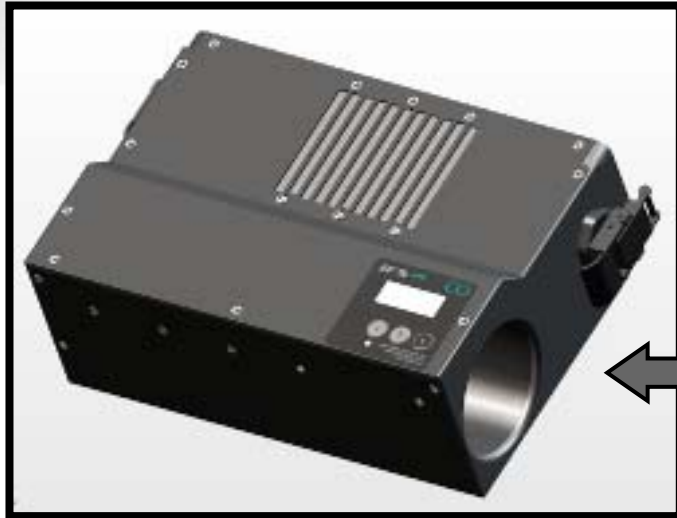


- Enables 4X – 6X Flight times

Product Development

Jadoo + Millennium Cell

SOCOM PSC-5D Radio



- 55 W nominal power
- Fits in 2 x BA 5590 battery box



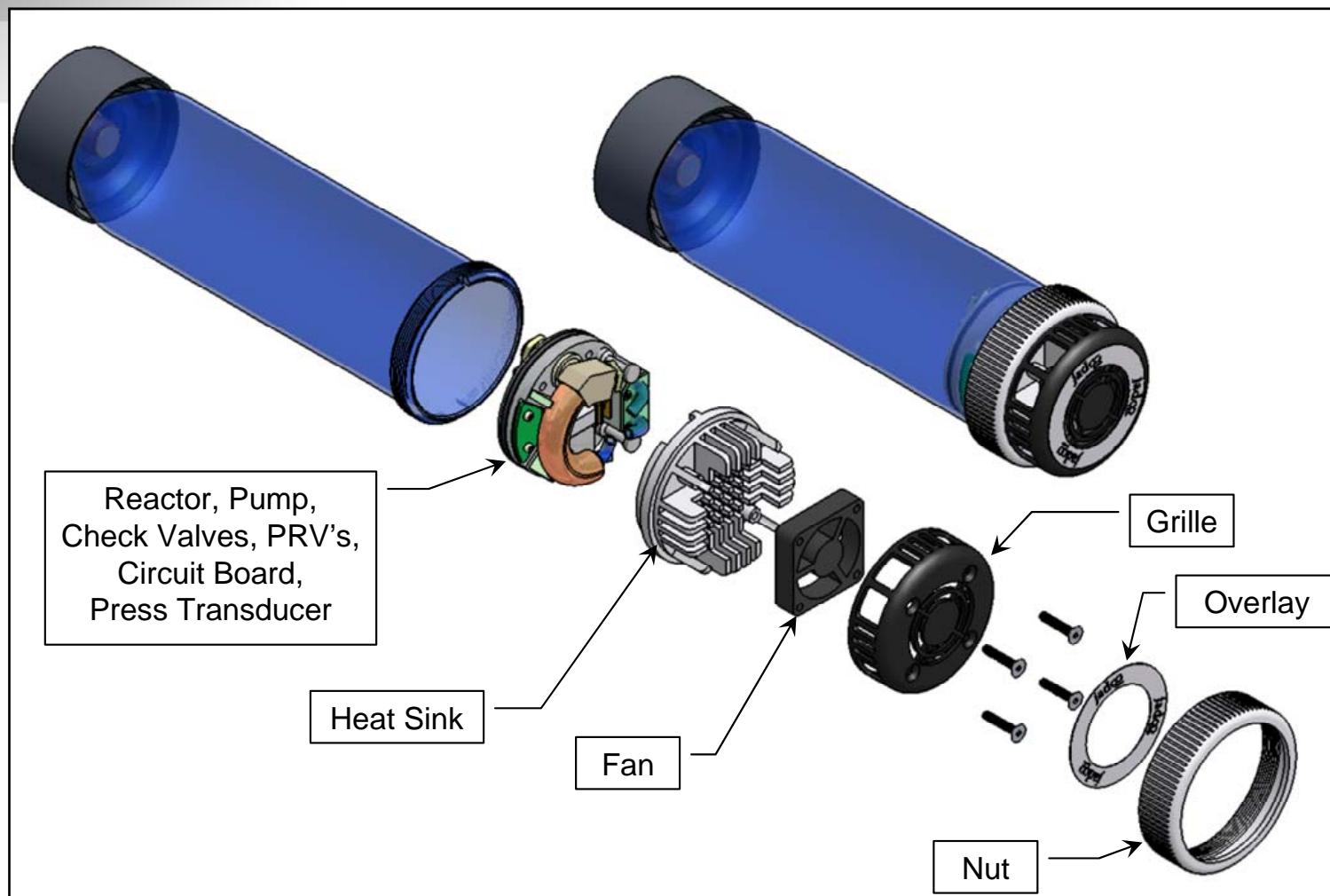
N-StorNB

eXtended Run Time



- 100 W Auxiliary Power
- 2200 Wh Energy
- 110 V, 12 V interface

Cartridge Detail View N-StorNB (NB: Sodium Borohydride)



Value Proposition

Special Operations Radio

Based on 11 day mission	Jadoo & MCEL Fuel Cell System	BA-5590 Battery
Configuration for mission	1 Fuel Cell 7 x 500 W-hr Fuel Cartridges	35 Battery Packs
Weight of System	11 kg (24 lbs)	36 kg (79 lbs)



Status: First prototype demonstrated Sept. 2006
Delivery to SOCOM in Q2-07

Competitive Advantage: Field hydration, non-flammable fuel
66% lighter than BA5590

Product Development

Cartridge manufacturing

- Development programs to establish manufacturing technologies for cartridge components
 - ▶ Catalyst material / reactors
 - ▶ Fuel / byproduct assemblies
 - ▶ Cartridge shell
 - ▶ BOP components (e.g., pumps, valves)
- Materials and processes scaleable to higher volume production
- Recently established in-house manufacturing capacity to support initial cartridge sampling
 - ▶ ~250 cartridges for evaluation in South Carolina in 2007-8



Summary

- Significant Sodium borohydride (NaBH_4) expertise
- Novel Fuel Formulations offer higher energy density
- Portable systems being evaluated by military partners → Field Trials this year
- Technology development → product development / manufacturing
- Developing 3 – 5 Watt passive fuel cell systems

Thank you!