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An update on CERDEC fuel cell technology research, development, and demonstration is provided.
Army Power Division & CERDEC Fuel Cell Team Missions

Sensor & Soldier Power
- Potential Benefits
- Recent Test Results

Man Portable Power
- Potential Benefits
- Recent Test Results

Demonstrations & Exercises
- Aberdeen Test Center
- Joint Readiness Training Center, Ft. Polk
- West Point Military Academy
Army Power Division Mission

To conduct research, development, and system engineering leading to the most cost-effective power, energy, and environmental technologies to support Army’s soldier, portable, and mobile applications.

ATO D.CER.2008.08
Power for Dismounted Soldier
- Half-Sized BA5590 Li/CFx Battery
- Half-Sized BA5590 Li-Air Battery
- Soldier Conformal Rechargeable Battery
- Soldier Hybrid Methanol Fuel Cell Power Source
- Soldier Hybrid Fuel Cell Power Source
- Portable Hybrid Power Sources & Chargers, JP-8 fueled

ATO R.LG.2009.01
Mobile Power
- Transitional Hybrid Power Source, Log-fueled
- Waste Heat Recovery
- Power Centric Mobility applications
CERDEC Fuel Cell Team
Our Mission

To Rapidly Develop & Transition Suitable Fuel Cell Technologies to Applications where they are Most Needed

Soldier Power
5 – 100 W

Sensors
< 5 W

Man Portable
100 – 500 W

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.
Fuel Cells for Sensor and Soldier Power

Current Programs
&
Recent Lab Testing Results
Potential Benefit – Sensor and Soldier Power

➢ Longer runtimes than current batteries for comparable form factors
➢ Logistic advantages related to handling and lifecycle costs
➢ Cheaper than current batteries for comparable power needs
Cost Comparison for Operating Batteries vs. Fuel Cells

Potential Benefit – Sensor and Soldier Power
Sensor and Soldier Power
(100 mW – 100 W)

Fuel Technology

- Direct Methanol
- Reformed Methanol
- Chemical Hydrides
- SOFC
- Bio - Fuels

Current Efforts

- SFC Smart Fuel Cell
- UNF University of North Florida
- Samsung
- UltraCell High Power Micro Fuel Cells
- General Atomics
- jadoo Power
- AMI Adaptive Materials Inc.
- FFU Tennessee Tech University
- Akermin
UltraCell XX25 RMFC

In Development with CERDEC and DARPA

Rated 25W continuous
Reformed Methanol Fuel Cell (RMFC)
Fuel: 67% Methanol / 33% Water

Dimensions: 9.3" x 5.3" x 1.8"
Start Up Time: 20 min.

System Dry Weight: 1.2 kg
Fuel Cartridge Weight: 0.3 kg

25W Mission Energy Density:
24-hr 230 Whr/kg
72-hr 360 Whr/kg

System Energy Density of UltraCell XX25

Energy Density (Whr/kg) vs Time (Hrs)
UltraCell XX55 RMFC

Progression from XX25

Rated 55W continuous (110W Peak)
Reformed Methanol Fuel Cell (RMFC)
Fuel: 67% Methanol / 33% Water

Dimensions: 13" x 8" x 4"
Start Up Time: 25 min / Hybridized

System Dry Weight: 2.7 kg
System Efficiency: 26.0%

55W Mission Energy Density:
24 hr: 265 Whr/kg*
72-hr: 410 Whr/kg*

* Calculated based on initial data only
AMIe60 60W SOFC

Developed with CERDEC and DARPA

Rated 60W continuous (100 W Peak)
Solid Oxide Fuel Cell (SOFC)
Fuel: Commercial Propane Canisters

**Dimensions:** 10.25" x 9" x 4"

**Start Up Time:** 15min.

**System Dry Weight:** 2.8 kg

**System Efficiency:** 18.0 %

**60W Mission Energy Density:**
- 24 hr: 400 Whr/kg
- 72-hr: 760 Whr/kg
Fuel Cells for Man Portable Power

Current Programs
&
Recent Lab Testing Results
Potential Benefit – Man Portable

Auxiliary Power/ Battery Charging

- Bridge power gap between batteries and generators
- Greater efficiencies than TQGs and vehicle power
- Reduced noise and heat signatures
- Enables remote, portable battery charging capability where other power sources are not practical
- Low emissions
Man Portable Power
(100 W – 500 W)

Fuel Technology

- Direct Methanol
- Reformated Methanol
- Ammonia Borane
- Sodium Borohydride
- SOFC

Current Efforts

- INI POWER SYSTEMS
- Protonex
- Spectrum BRANDS
- Rayovac
- Ultralife Batteries
- Lynntech
- Protonex
- Ultralife Batteries

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.
Protonex P-125a SOFC

Developed with CERDEC & ARO

Rated 100W continuous
Solid Oxide Fuel Cell (SOFC)
Fuel: 100% Pure Propane

**Dimensions:** 14” x 6.75” x 3.75”

**Start Up Time:** 50 minutes

**System Dry Weight:** 6.9 kg
**Fuel Cartridge Weight:** 0.8 kg

**Fuel Consumption:** 38g/hr
**System Efficiency:** 18.6%
Recent Exercises & Demonstrations
Ballistic Testing:
Determine Fuel Cell and Cartridge Safety
.50 Cal Incendiary Rounds

Targets:
Fuel Cells in Operational Configuration
Propane Canisters
Methanol Cartridges

Results:
Benign Release of Fuel from Containers
No Incident on Fuel Cell Systems
Purpose:
Utilize the UltraCell XX25 RMFC as a Remote Power Source for Dismounted Soldier Applications

Feedback:
Users enjoy Hotswapable Capabilities
“…Good Mission Extender”

Environmental Conditions
Temp: 70-100°F
Humidity: 60-100%
West Point Military Academy
West Point, NY

Purpose:

Conduct a Human Factors Analysis on the UltraCell XX25 RMFC

Test Factors:

Ergonomics
Ease of use
Ability to Read Display (Fuel, Error Codes, etc.)

Testing Results:

Phase 1: August – December 2009 (Classroom)
Phase 2: Summer 2010 (Field Demo)
Conclusions

- Fuel Cells have shown great potential for meeting the increased energy needs of the dismounted soldier
- Many current systems have increased reliability and ruggedness moving from TRL 5/6 to 6/7
- No one technology has shown it will be the sole solution for the military – both fuel and fuel cell need to be safe and user acceptable
- Test and evaluation of fuel cell power systems plays a vital role in assessing the state of technology and transitioning to the procurement stage
Thank You!

Questions?