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ARMY POWER / COOLING



MIRCO / NANOTECHNOLOGY

FOR

MILITARY APPLICATIONS

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ARMY POWER



POWER is often an AFTERTHOUGHT

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ARMY RESEARCH AND DEVELOPMENT CENTER



ARMY POWER DIVISION



FUTURE FORCE POWER R&D Program

- ❑ Provides critical power for Future Force C4SIR Equipment
- ❑ Provides seamless energy availability for both **MOBILE** and **SOLDIER** Applications
- ❑ Develop, Demo & Transition Power Sources, Battery Chargers & Pwr Mgmt:
 - ❑ Higher Energy
 - ❑ Lighter Weight
 - ❑ Quieter
 - ❑ Fuel & Cost Efficient





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Current Battlefield Power Issues



MOBILE

Tactical Operation Center



SBCT I

- ~1,200 gals fuel/day fuel to theater; costs vary (\$13 - \$133/gal)
- \$45K-\$465K (72 hrs)
- 12 TONS Fuel!

SBCT I

- 133 Generators (MTOE)
- Too Large, Too Noisy, Not Fuel Efficient
- Redundant Generators
 - (40% - 50% Excess Power)
- No Smart Power Distribution
- 68 TONS of generators!

SOLDIER

Forward Area Environment

Brigade

- \$300K for 72 hrs
- 7 TONS of batteries!



- Disposable batteries are costly
- Available energy NOT fully utilized
- No Recharge capability
- Too many battery types



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Future Force Power R&D Program



GOALS (FY05-08):

- Reduce energy consumption & increase carried energy density
- Reduce logistics footprint for power
- Fill “power gap” between batteries and diesel generators



Mobile Products



Soldier Products



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Soldier Products



Stand-alone Manportable Field Chargers

- Quiet Power 200-500W; Stirling & Fuel Cell Technologies
- Less than 10 kgs, logistics fueled



Soldier Hybrid Power Sources

- “Mission Extender” for 72 hr Mission
- 1.5 lbs dry weight, 600 Whrs/kg

Power Management Software & Methodologies

- Demonstrate 75% power savings



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Mobile Products

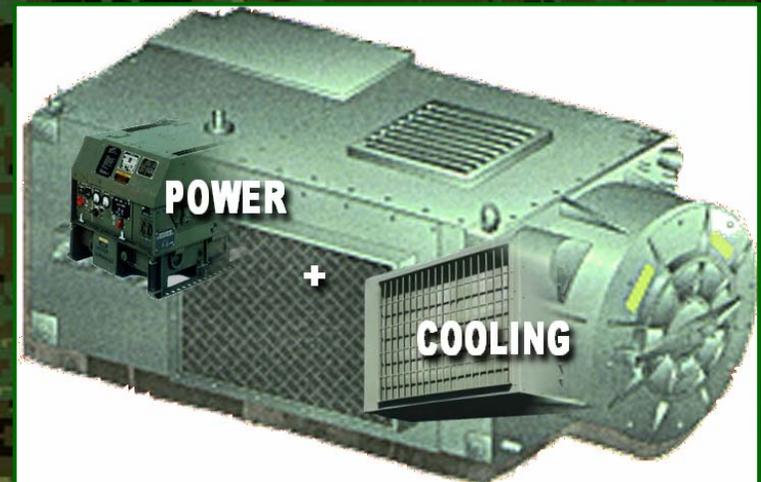


Quiet Logistics Fueled 1-2kw Power Sources

- Less than 69 dBA
- Develop Stirling Engines and Fuel Cells
- Develop component technologies for using logistics fuel

Co-generation Power-Cooling Systems

- Develop component technologies for tactical heat-driven cooling systems
- Integrate with 5kW Power Source
- 50% less fuel consumption





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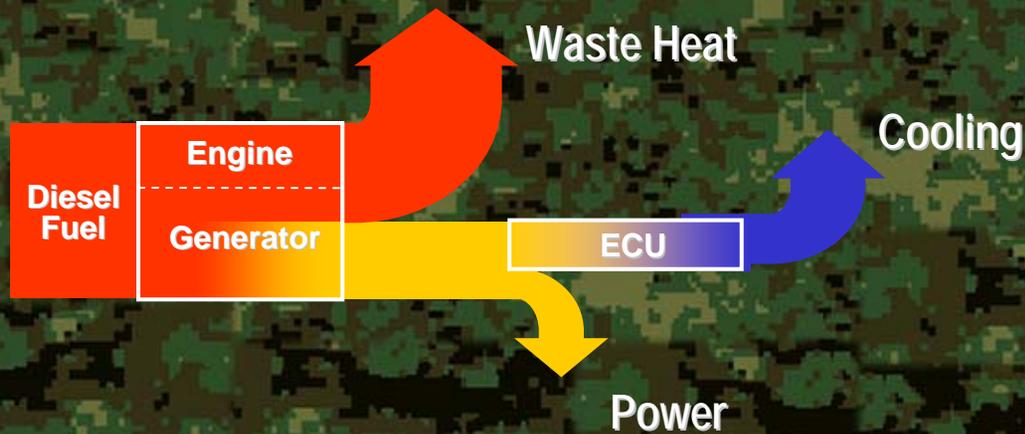


COGENERATION POWER & COOLING



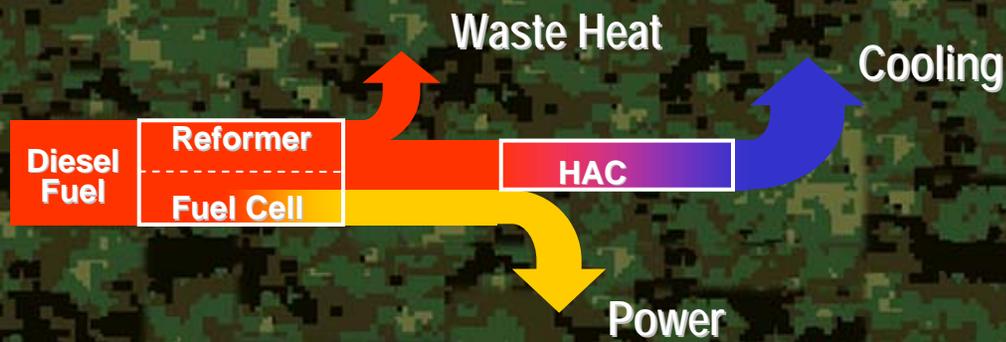
CONVENTIONAL POWER & COOLING

System Efficiency = 25%



CONGENERATION POWER & COOLING

System Efficiency = 60-70%

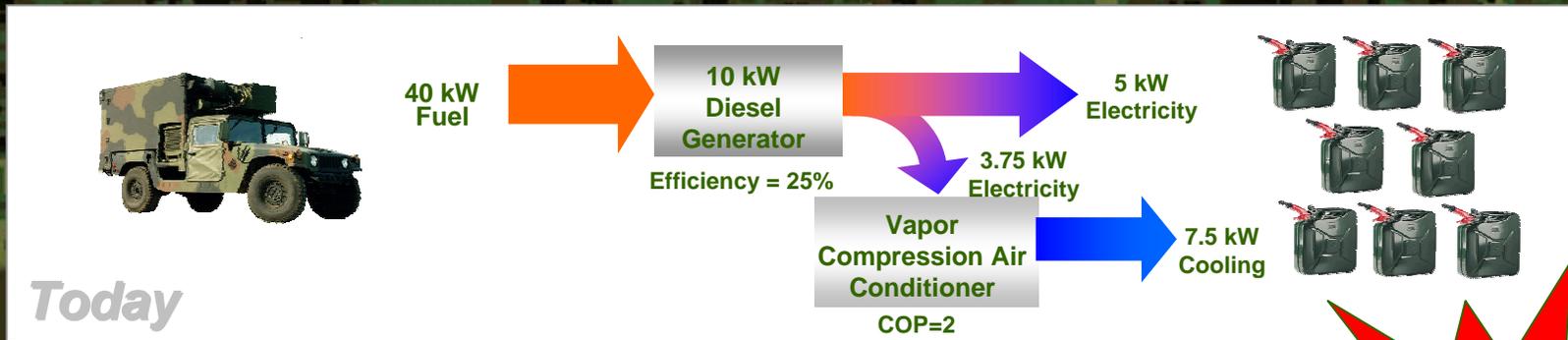




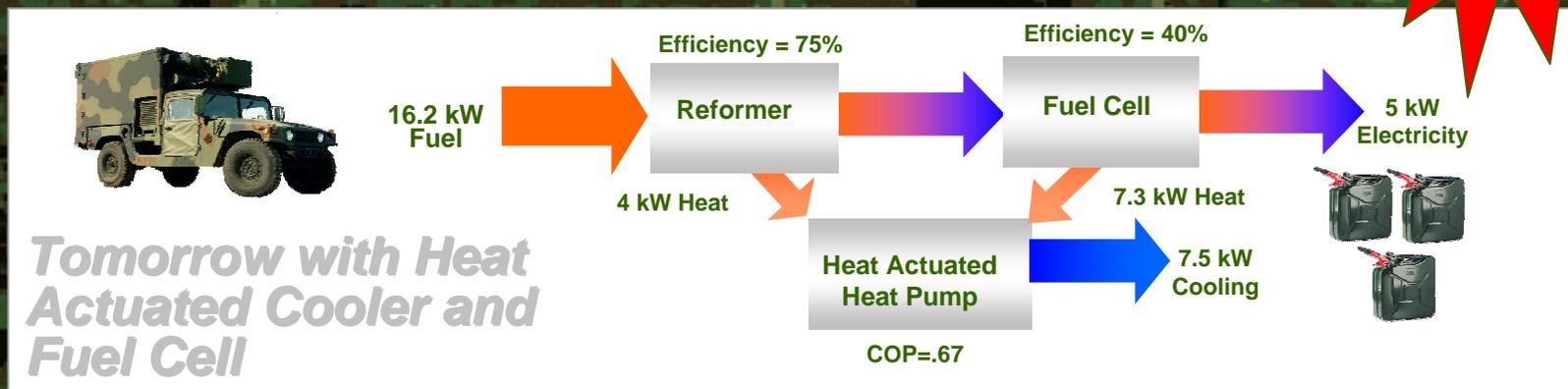
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COGENERATION POWER & COOLING



fuel reduction > 50%

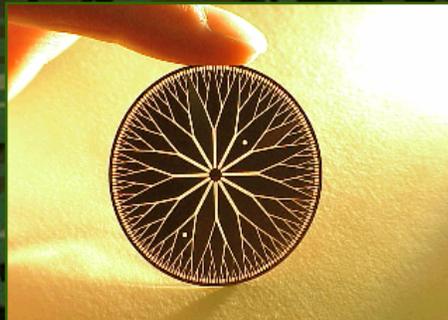




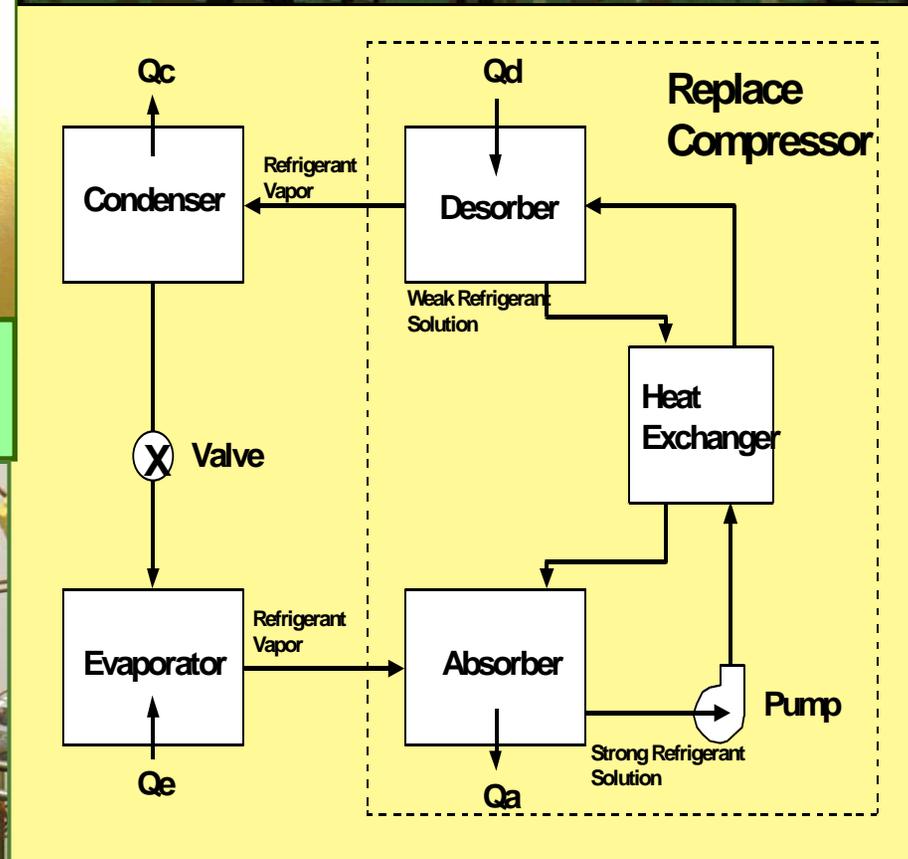
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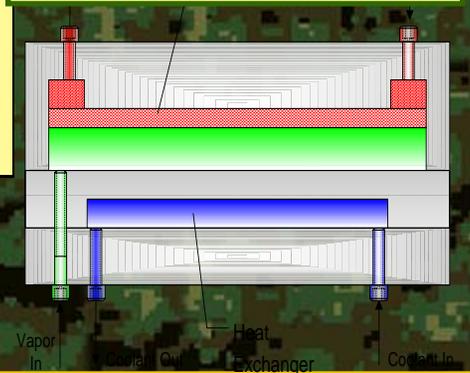
Heat Actuated Cooling



Fractal Desorber
(100 μm channels)



Microwick Absorber
(310 μm channels)





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Heat Actuated Cooling



Commercial Design

- Cooling load: 5,000 Watt @ 120°F ambient temperature
- Size: 28 ft³
- Weight: 595 lbs.

Microtechnology Design

- Cooling load: 5,000 Watt @ 120°F ambient temperature
- Size: 10 ft³
- Weight: 290 lbs.



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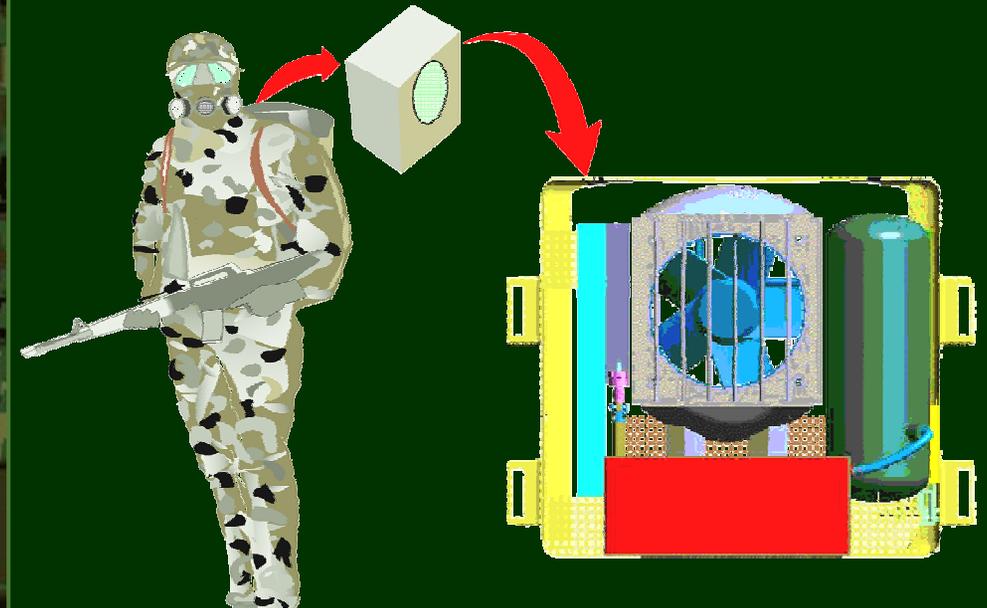


Microclimate Cooling



Current Design

- Cooling load: 350 Watt @ 120°F ambient temperature
- Weight: > 20 lbs (9 kg)
- Powered: Batteries (300 lbs for 72 hr mission)



Microtechnology Design

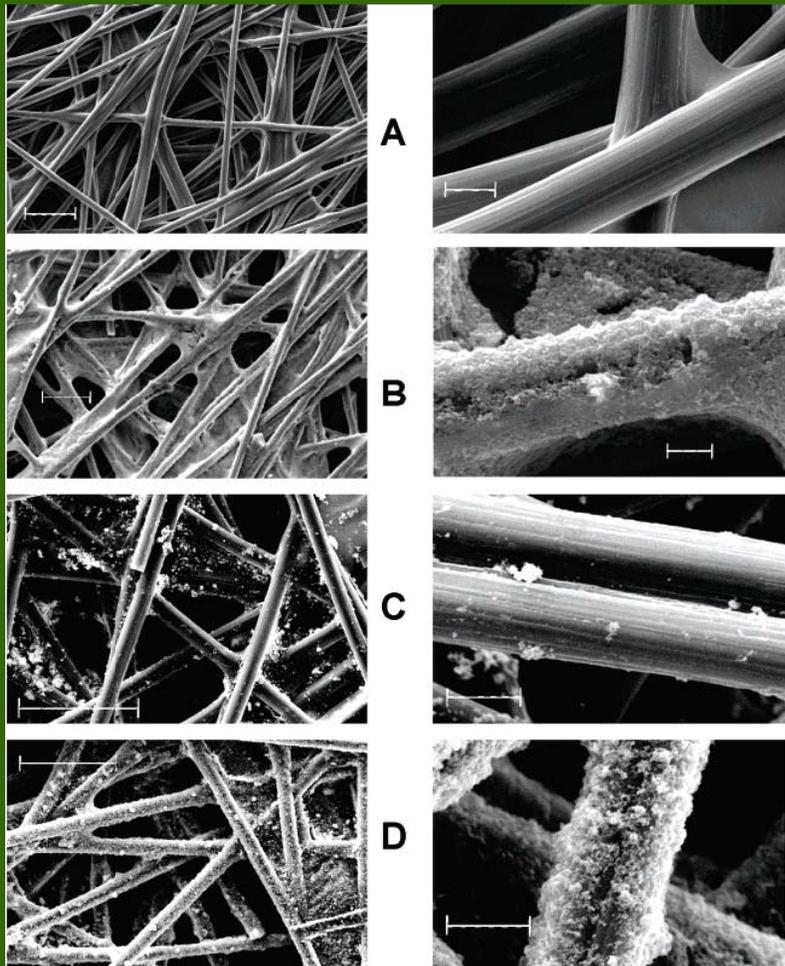
- Cooling load: 350 Watt @ 120°F ambient temperature
- Weight: < 7.0 lbs (3.2 kg)
- Powered: Fuel (5 lbs for 72 hr mission)



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Fuel Cell Electrodes



Nanomaterials As Electrocatalyst Support

- Reduced precious metal loading
- Lower System Costs
- Increased Surface Area
- Increased Current Generation



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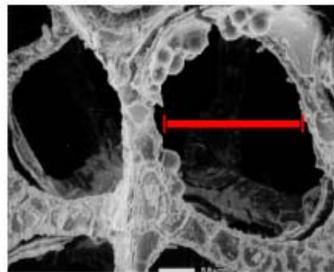
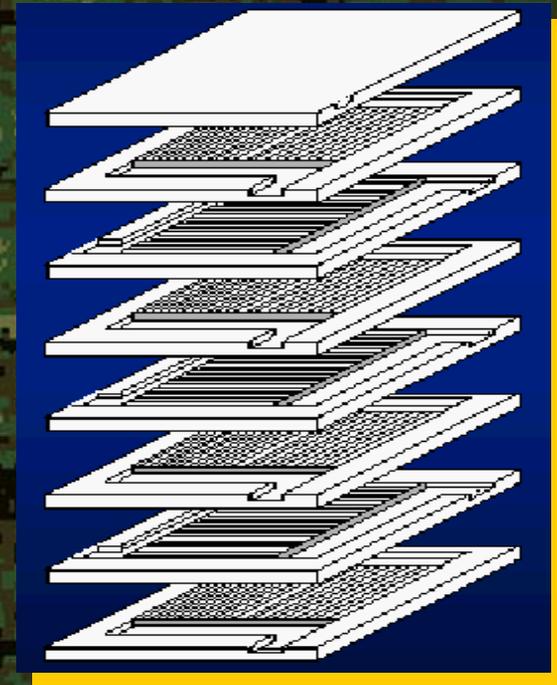


Fuel Reformer Design



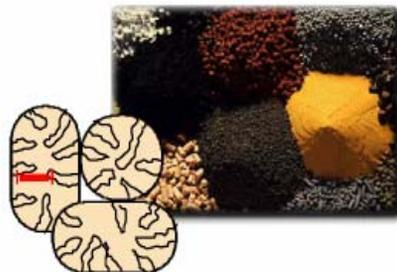
Microchannel Reactors offer:

- Enhanced Heat Transfer
- Enhanced Mass Transfer
- Economics of Mass Production
- High Surface Area to Volume Ratio
- Low pressure Drop Through Channels



~ 0.02 cm

VS.



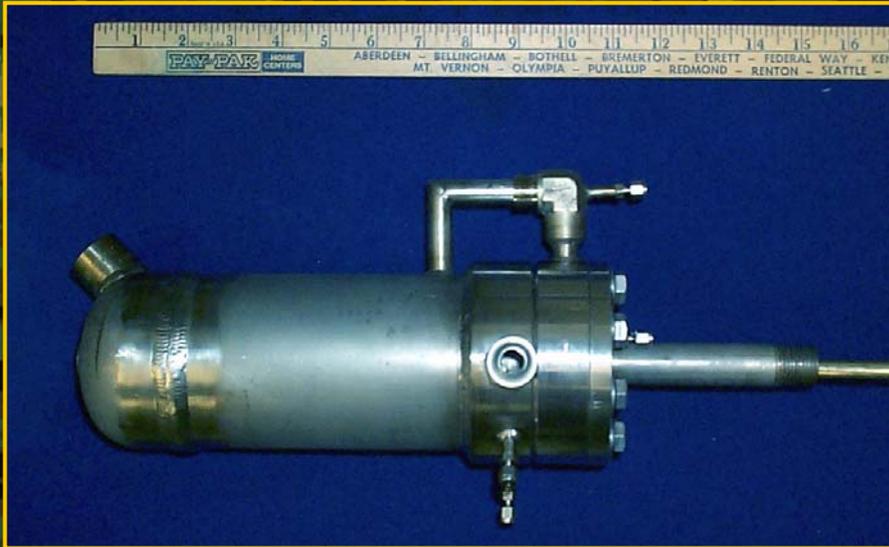
~ 2 cm



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Diesel Fuel Reformer



InnovaTek Initial Design

- 1 kWe Steam Reformer
- Channel Dimension $\approx 10,000 \mu\text{m}$
- Flow Rate (GHSV) $\approx 15,000/\text{hr}$
- Weight $\approx 13 \text{ kg}$
- Volume $\approx 2.3 \text{ L}$

InnovaTek Gen2

- 2.0 kWe Steam Reformer
- Channel Dimension $\approx 750 \mu\text{m}$
- Flow Rate (GHSV) $\approx 100,000/\text{hr}$
- Weight $\approx 5.5 \text{ kg}$
- Volume $\approx 1.9 \text{ L}$



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NANOTECHNOLOGY



FUTURE SOLDIER

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Business Opportunities



COOLING TECHNOLOGY

**Broad Agency Announcement:
W909MY-04-R-0025**

FUEL CELL TECHNOLOGY

**Broad Agency Announcement:
W909MY-05-R-0004**

Listed under Contracting Officer, Patricia Davis on the Army Single Face to Industry Interactive Business Opportunities Page (<https://abop.monmouth.army.mil/>).

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