SECA Project at Siemens Westinghouse

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Siemens Westinghouse Power Corporation
Stationary Fuel Cells

Who Are We?

- We are a Business Unit of 200 employees within Siemens Westinghouse Power Corporation.
- Our charter is to commercialize factory built SOFC Power Systems (3 kWe to 10 MWe) for the distribution generation market.
- Our focus is the seal-less, tubular SOFC concept.
- We have expertise in the following fields:
  - High Temperature Materials
  - Ceramic Processing
  - R&D and High Temperature Testing
  - Hydrocarbon Reformation
  - SOFC Module and Systems Engineering/Design
  - Ceramic Powder, Cell and Module Manufacturing
  - BOP Assembly
  - Systems Testing
What Have We Accomplished?

- Developed the state-of-the-art, 150 cm active length, cathode supported, tubular SOFC.
- Demonstrated lifetimes of >60,000 operating hours with voltage degradation rates of less than 0.1% per 1000 hours, and thermal cycle capability of >100 cycles.
- Manufactured over 15,000 state-of-the-art SOFC’s.
- Developed our proprietary internal reforming technology.
- Designed, manufactured and tested complete power systems.
- Began construction of our 15 MWe per year Commercial Manufacturing Facility in Pittsburgh, PA.
100 kWe Combined Heat & Power (CHP) System
- 20,500 operating hours (16,500 hours in The Netherlands and 4000 hours in Germany).
- 46% electrical efficiency, 75% CHP efficiency on PNG.
- No measurable voltage degradation.

200 kWe Pressurized Hybrid (PH) System
- Combines a pressurized SOFC with an MTG.
- 1700 operating hours to date (University of California, Irvine)
- 52% electrical efficiency on PNG.
- Stable voltage.
Future SOFC Power System Demonstrations

- 250 kWe CHP System in Ontario, Canada (2002).
- 300 kWe PH System in Essen, Germany (2002).
- 300 kWe PH System in Milan, Italy (2002).
- 250 kWe CHP System in Alaska (2003).
- 250 kWe CHP System in Hannover, Germany (2003).
- 250 kWe CHP-Zero Emission System in Norway (2004).
- Other projects under negotiations.
What are our Top Three Commercial Issues?

1. Product Cost
2. Product Cost
3. Product Cost

Commercial Prototype Fuel Cell Power Systems (e.g., PAFC) have historically been in the $4000 to $5000/kWe cost/price range.
SECA Program Objectives

- Develop SOFC system prototypes for the remote, residential, military and APU markets with a net power output of 3-10 kW.

- Ultimate cost goal - $400/kW in 2012.
SOFC Power System Demonstrations with State-of-the-Art SOFC’s

Technology Team

- SWPC
- Fuel Cell Technologies
- Blasch Ceramics
- ZIRCAR Refractory Composites
- Universities

Customer/Market Teams

- **Stationary**
  - Fuel Cell Technologies
  - Lennox Industries
  - Trane
  - Dominion Resources
- **Transportation**
  - Ford Motor Company
  - Eaton Corporation
- **Military**
  - Newport News Shipbuilding
  - Eaton
Technical Approach

- Improve cell performance thru seal-less planar SOFC concept.
- Low temperature (~800°C) SOFC development to allow for lower cost module materials.
- Ultra-low cost SOFC materials and manufacturing process development.
- On-cell reformation.
- Sulfur tolerant anode.
- Cost-effective fuel processing including liquid fuels.
- High efficiency power conditioning.
- High degree of design integration and simplification.
SWPC SECA Cell Technology

- Maintains Seal-less planar design
- Reduction in resistance and cell cost
- Increase in cell power (power density and surface area)
- More compact stack

2.2 cm Cylindrical (Present)
Seal-less Planar
Cell Performance Comparison

Cell Power [Watts]

Current Density [mA/cm²]

Cell Voltage [Volts]

Voltage - 2.2cm

Power - 2.2cm

Voltage - Seal-less Planar

Power - Seal-less Planar

Phase 1

Phase 2

Phase 3
HPD4 Seal-less Planar Cell
At half the length, the seal-less planar cell will produce 50% more power.
Bundle Comparison
5 kW Power System - Simplified Flow Schematic
5 kWe Power System Model - SECA Vision

- Exhaust Heat Exchanger
- Siemens-Westinghouse 5kW Cell Stack
- Gas Control Valve For Start-up Heater
- Gas Shut-off Valve For Start-up Heater
- Desulfurizer
- Cell Stack Gas Control Valve
- Cell Stack Gas Shut-off Valve
- Primary and Backup Air Blowers

Data Display

10kW DC/AC Inverter

Inlet Air Filter

Control Computer and Electronics

Pb/Acid Battery Pack

24”L x 31” W x 67”H

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Summary and Conclusions

First Commercial CHP250 Units by End 2003

- Expensive.
- Limited market entry penetration in early years.

SECA Program

- Revolutionary technology advancements to reduce cost.
- Catalyst for broad market penetration and new market creation.
- New opportunities for small or emerging U.S. suppliers.
- Knowledge and capabilities creation in our Universities.