

Update on NYSERDA Fuel Cell Projects

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NYSERDA's Overall Mission

- Public Benefit Corporation and a Component Unit of the State of New York
- Goals:
 - Promote Energy Efficiency
 - Encourage Economic Development
 - Expand the Use of New York State's Indigenous and Renewable Energy Resources
 - Reduce or Mitigate Adverse Environmental Effects Associated with Energy Production and Use
- Funding: primarily from assessment on intrastate gas & electricity sales & SBC on consumer electricity bills

NYSERDA R&D Strategy

- Implement a program that supports:
 - Feasibility analyses to evaluate project potential and viability
 - Develop and demonstrate enabling technologies
 - Product development, testing, and evaluation
 - Demonstrate the effectiveness of energy technology applications



History

- NYSERDA began partnering in PEM fuel cell technology in 1992
- \$3M investment in fuel cell development from 1992-97
- \$6M investment from 1998 to May 2002
- Several New York State companies including Plug Power's predecessor - MTI
- 50KW PEM fuel cell for passenger cars

80 Unit PEM Fuel Cell Demonstration

- 3 Phase project to build, test, evaluate and demonstrate 80 Plug Power 7 kW fuel cells
- Project kick-off May 1999
- \$6M project (\$3M funding provided by through New York State Clean Air Clean Water Bond Act of 1997 matched by equal funding by Plug Power)
- Deploy units at publicly-owned and accessible facilities across the state
- Verify the clean, environmentally friendly nature of PEM fuel cells and garner public support for their early introduction
- Accelerate wide scale commercialization

80 Unit Fuel Cell Demonstration Project



Phase 1

Phase 3



Phase 2

80 PEM Fuel Cell Demonstration

- PEM Fuel Cell Demonstration (cont'd)
 - Phase 1 - Laboratory evaluation of 24 pre-production prototypes (5/99-3/00)
 - Phase 2 – Initial field evaluation of 6 pre-production prototype units (3/00-7/00)
 - Phase 3 – Demonstration of 50 advanced design pre-commercial units commenced (8/00-12/01)

80 Unit PEM Fuel Cell Demonstration

- Phase 1 - Laboratory evaluation of 24 pre-production prototypes 5/99-3/00
 - Build an experience database for failure mode effects analysis under simulated field conditions
 - Establish operating strategies for selected applications
 - Understand & integrate sub-system modules



80 Unit PEM Fuel Cell Demonstration

- Phase 2 - Initial field evaluation of 6 pre-production prototype units (3/00-7/00)
 - incorporate knowledge gained from phase I, to improve performance and/or reduce cost
 - identify initial field installation/operation issues
 - Maintenance schedules developed
 - Validation of field service procedures



80 Unit PEM Fuel Cell Demonstration

- Phase 3 - Demonstration of 50 Test & Evaluation Units (8/00-12/01)
 - Incorporate information gained and design changes from Phases 1 & 2
 - First factory assembled systems
 - First self-enclosed units
 - Intended to achieve essentially unattended operation
 - Measure performance and emissions





Phase III Site Examples





National Fuel Gas/Plug Power

- National Fuel Gas – gas utility serving western NY
- Plug Power 5kW Fuel Cells at two residences in their service area – will operate for 1 year
- Identify the process and issues surrounding installation of fuel cells for residential applications
 - Evaluate initial planning, site selection and preparation, permits, grid interconnection, and operation and maintenance from a gas utility perspective





National Fuel Gas (cont'd)

- “Best Practices” Guide for installation, operation and maintenance of fuel cells will be produced by contractor
- Status: Units commissioned April 2002
- Update – IBACOS funded by DOE Building Technology Office to monitor the residence’s load profile
- NYSERDA has entered into collaborative agreement with the Greenhouse Gas Technology Center under the EPA sponsored Environmental Technology Verification Program for one site
- Verification parameters:
 - Power output & quality
 - CO₂, CO, HC, NO_x
 - GHG & NO_x reduction estimates
 - Efficiency



Verizon/Plug Power

- Verizon's growth model includes "distributed switching" (vs. central switching offices)
- 5 KW Plug Power fuel cell to power remote switching huts when grid electricity not available (vs. lead acid batteries)
- Represents new opportunity for entry in premium power commercial market sector
- System commissioned Feb '02
- 2009 hours as of 5/23/02
- >98+% availability Mar-Apr





Plug Power Case Study - Watervliet Arsenal

Site and Facility Challenges

Potable Water Requirements

- Tested at 11-12 grains of hardness
- In-line scale inhibiting cartridges installed to pre-filter water
- Extend filters from 2 wks to 6 months / Usual filter life is 12 months

Water Pressure Constraints

- Back flow preventor required by physical plant personnel
- Available water pressure dropped from 58 to 32psi
- SU1 requires minimum 40psi for DI Filter assembly
- Additional booster pump installed
- Increased installation costs



Plug Power Case Study - Watervliet Arsenal

Electrical Interconnection

- Site currently utilizes $> 40\text{MW}$ of electricity
- Local utility requested a coordinated electrical review
- Multiple transformers between SU1 and Point-of-common-coupling
- Arsenal did not apply for an interconnection review
- Estimated cost savings between \$20K-\$40K



Plug Power Case Study - Watervliet Arsenal

Power Quality

- Existing electric service voltage levels fluctuated +/- 5-10V rms
- Fluctuation exceeded inverter anti-islanding tolerances
- IEEE P929, UL 1741, and NYS PSC requirements
- “Loss of Grid Fault” caused anti-islanding sequence
- Arsenal personnel re-tapped transformers to correct fluctuations



DG/CHP Product Development/ Demonstration Projects

- PON 669 issued December 2001
- \$10M total available
- Power Systems Technologies, DG, CHP
- 146 proposals received (13 relating to fuel cells)
- Awards expected to be announced by end of June 2002
- Next solicitation release expected before end of this year