Accelerating Acceptance of Fuel Cell Backup Power Systems

Project ID: ARRAH2007
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Project Overview

**Timeline**
- Start: June 1, 2009
- Finish: December 31, 2011
- 38% complete

**Budget**
- DOE: $2.7 MM
- Cost-share: $2.7 MM

**Barriers**
- Cost
- Affordability
- System reliability
- Market volume

**DoD Partners**
- Warner Robins AFB
- Construction Engineering Research Laboratory (CERL)
Relevance

- Demonstrate market viability and increase market pull of hydrogen and fuel cell systems within our government customers/partners

- 15-30% of Plug’s technical staff are supported by this funding effort

- Large automotive supply base is delivering stack, reformer and balance of plant components

- Deploy 20 GenSys hybrid hydrogen start/LPG or natural gas run units that provide economically viable backup power in excess of 72 hours
  - Increase distributed power generation
  - Improve reliability and efficiency of mission critical backup power
  - Decrease fossil fuel dependencies for power generation
Approach

Backup Power
- Hydrogen fueled
- Start time < 1 minute
- Run time = 4 hours

Extended Backup Power
- Hydrogen and LPG fueled
- Start time < 1 minute
- Run time = indefinite

Continuous Power
- LPG fueled
- Start time = 3 hours
- Run time = indefinite
Approach

- Cost Analysis and Commercialization Study 85% complete
- Site Planning and Applications Engineering 30% complete
- Site Specific Engineering Development 0% complete
- Systems Builds and Factory Testing 20% complete

**Go/No Go:** After 20 simulated extended run power outage profiles, the system must be able to produce 6kW of DC power at a combined efficiency of >24% using propane available at Plug Power’s Latham facility

- Fleet Operation and Managed Services 0% complete
- Project Closeout 0% complete
- Program Management 38% complete
## Cost Analysis

- The GenSys offers economic as well as environmental benefits over the incumbent diesel generator technology.

- Near threefold advantage in system life with only 20-25% higher maintenance costs than a diesel generator.

- The GenSys offers the customer a 20 to 30% decrease in power generation expense.

### Telecom Cell Tower Application Comparison (4.5 kW Case)

<table>
<thead>
<tr>
<th>GenSys System</th>
<th>Features</th>
<th>Diesel Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td>43,800 Hours (5 Years)</td>
<td><strong>System Life</strong></td>
<td>15,000 Hours (1.71 Years)</td>
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<tr>
<td>System, Inverter, Batteries 2.4% less</td>
<td><strong>5-Year Capital Costs</strong></td>
<td>3 Generators, AMF Panel, PIU, SMPS, Batteries 2.4% more</td>
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<tr>
<td>Range: 20% to 32% 4.5 kW Point: 29.1% (BOL)</td>
<td><strong>Efficiency</strong></td>
<td><strong>Range</strong>: 7% to 21% 4.5 kW Point: 18.5% (BOL)</td>
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<td>LPG, potential to run on a range of hydrocarbons</td>
<td><strong>Fuel Type</strong></td>
<td>Diesel</td>
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<td>75-85% less fuel expense than diesel generator</td>
<td><strong>5-Year Fuel Costs</strong></td>
<td>75-85% more fuel expense than fuel cell</td>
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<tr>
<td>Comparable maintenance 20-25% more than DG</td>
<td><strong>5-Year Maintenance Costs</strong></td>
<td>Comparable maintenance 20-25% less than FC</td>
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<tr>
<td>&gt;99%</td>
<td><strong>Reliability / Availability</strong></td>
<td>&gt;99%</td>
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<td>7.0 metric tons of C, 0.4 g of NOx, 0.06 g of SOx, 0.51 g of CO annually</td>
<td><strong>Emissions to Environment</strong></td>
<td>14.4 metric tons of C, 743 g of NOx, 49 g of SOx, 160 g of CO annually</td>
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<td>65 dBA at 3 m</td>
<td><strong>Noise Level</strong></td>
<td>75 dBA sheltered 92 dBA unsheltered</td>
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BOL = Beginning of Life
Technical Accomplishments- Cost Analysis

- An economically viable path to 72 hours worth of backup power with a pure hydrogen solution was not determined.

- Focus shifted to the success of a hydrogen start with LPG/natural gas run.

- This solution provides the economics needed for a flexible backup power solution.
Technical Accomplishment- Site Selection

- Plug Power visited DDWG for site review in March 2010
- DDWG requires extended backup to enable base service operations
- Server room and the HVAC
- Hydrogen availability on the base is not an issue, but proximity and logistics may be difficult and costly

DOE has agreed to closeout the DE-FG36-07GO17017 program and include the CERL demonstration in this program
Technical Accomplishments- System Build

- Reformer Qualification Testing
- Stack Qualification Testing
- Motor Controller Development and Qualification Testing

Module testing and qualification for Fleet #1
Technical Accomplishments- System Build

Fleet #1- First 5 systems under build and starting debug
Proposed Future Work

- Plug Power intends to have site selection completed this quarter
- Assembly and debug will continue on the first fleet of units
- Initiate the structured load cycle testing

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<td>Site Preparation</td>
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<td>System Test (Lab)</td>
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<td>System Operation</td>
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<td>Data Collection &amp; Analysis</td>
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Summary

Relevance: Demonstrate market viability by deploying 20 GenSys units

Approach: Leverage technology from two existing products to create GenSys extended backup power

Technical Accomplishments and Progress:
- Engaged CERL in site selection
- Discussed site requirements with DDWG
- Began system assembly and debug

Technology Transfer/Collaborations:
- CERL, Warner Robins AFB

Activities for Future:
- Site a unit at CERL
- Continue site discussion with DDWG
- Complete site selection