X.3 Accelerating Acceptance of Fuel Cell Backup Power Systems

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Subcontractor:
IdaTech, Bend, OR

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Project End Date: September 2013

Objectives

- Create new jobs as well as save existing ones; spur economic activity
- Accelerate the commercialization and deployment of fuel cells, fuel cell manufacturing, installation, maintenance, and support services
- Demonstrate market viability and increase market pull of fuel cell systems within our government customers/ partners

Relevance to the American Recovery and Reinvestment Act (ARRA) of 2009 Goals

- Jobs created at Plug Power including engineering, testing, sales, marketing, program management
- Commercialization and enablement of the fuel cell supply chain, including DANA, BASF, 3M, etc. as well as collaborations with other partners such as IdaTech and site installation support subcontractors
- Increased distributed power generation through the deployment of 20 GenSys systems
- Improved reliability and efficiency of mission critical backup power (>72 hours)
- Decrease fossil fuel dependencies for power generation

Technical Barriers

- Obtaining permitting from utility companies to operate fuel cells in a grid parallel (grid tied) configuration.

The following body of work was provided to the utility however the utility decided it was not sufficient.

  - Generating Facility Interconnection Application
  - Scope of Work for Fuel Cell Installation
  - Project Scope
  - Description of Work
  - Proposed Location and Build Layout
  - Concrete Pad Detail
  - Equipment Grounding Detail
  - Location of Fuel Cell Systems, Gas Piping, and Electrical Components
  - Site Electrical Wiring Diagram
  - Inverter Electrical Wiring Diagram
  - Equipment List and Specification
  - Contractor Requirements
  - Building Plans for Original Construction of Building (Host Site)
  - Map of Existing Renewable Energy Currently Installed at Host Base
  - Safety Plan and Emergency Procedure for GenSys Fuel Cell Fleet at Host Base
- The following was requested before permitting would be available:
  - Entire map of site host's interconnected generation - A complete and comprehensive single-line diagram of the entire generating facility's electrical configuration will be required. This application requires substantially more detailed information to ensure compliance of all tariffs and standards.
  - Single-Line Diagram - comprehensive diagram of the complete electrical configuration of the entire facility.
  - Three-Line Diagram - detailed protection study; phase and polarity identification.
  - Elementary Diagram - comprehensive representation of the entire facility containing information of all components electrically connected.
  - Plot Plan Drawing - needs update to include physical location and distances of all components
  - Relay Diagram - Diagrams and written descriptions regarding protective relays that will be used to detect faults or abnormal operating conditions for distribution system.

  - Proposed Relay Settings - Demonstrate how the unscheduled and uncompensated export of real power from a generating facility for a duration exceeding two seconds but less than 60 seconds will be accomplished; for the proposed transfer switch, details to ensure that the automatic transfer switch and scheme comply with Rule 21 requirements.
  - Relay test report will be required once the proposed relay settings have been reviewed and approved by protection engineering.

Technical Targets and Milestones

- Install 20 proton exchange membrane fuel cells for backup power at two site hosts by September 2012
- Backup power >72 hours

Accomplishments

- Successful installation, commissioning, and decommissioning of the first fleet of 10 GenSys units at Site Host 1, resulting in the following metrics for backup power:
  - 13,506 operating hours
  - 39.07 MW-hr electricity produced
  - Electrical efficiency = 25.4%
- A network outage simulation occurred on Saturday, January 19, 2013, 5:00 PM. The fuel cells powered the lighting in the building without issue. The commercial utility power was turned off - main disconnect switch SW1. Within ~20 s, the relays transferred and lighting was restored by fuel cell system power. Network outage simulation was roughly 30 minutes.
- Successfully installed the second fleet of 10 GenSys unit at Site Host 2.

INTRODUCTION

Extending the amount of backup power that is available to U.S. agencies provides flexibility to their emergency planning. If an outage occurs due to a natural disaster, for example, these agencies have more time to react to the issue at hand instead of applying resources to regaining power. The intent of this project is to demonstrate two fleets of backup-power fuel cells as a validate solution for backup power requirements of greater than 72 hours.

APPROACH

The approach for extended backup is the merging of two Plug Power products – the GenCore and GenSys systems. By combining the field experience of the GenCore in backup applications with the long run time of the GenSys system, extended backup is achieved (see Figure 1).

RESULTS

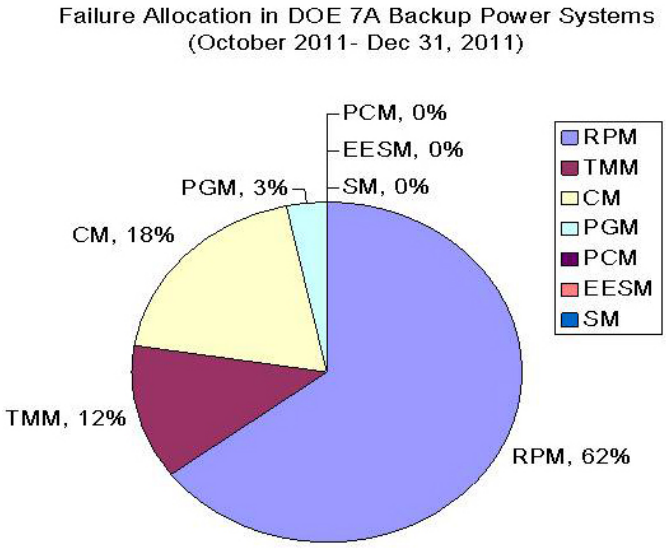
As outlined in the Accomplishment sections, the fleet of 10 GenSys units at Site Host 1 was successful in providing

FIGURE 1. Approach

backup power and continuing to maintain power to the facilities through a network outage simulation.

A list of future work has been compiled based on the field experience in operating this micro fleet. This list includes the definition of failure modes, failure signatures/ symptoms for future work to create early detection and recovery methods (see Figure 2):

- RPM: Autothermal oxidizer timeout waiting for catalyst activation
- CM: Electronic board failures, some possible connection to software
- RPM: Loss of fuel flow (related to flow meter/valve issues)
- TMM: Coolant leak, loss of coolant
- RPM: Anode air pump failed to start, known issue
- RPM: Gas leak during commissioning
- CM: Unknown, attributed to electronic boards
- RPM: Fuel flow issue with occasional dropout or flow spikes
- PGM: Max low cell trips, stack protection due to either CO or cell performance
- RPM: Desulfurization needed excessive time for conditioning/equilibration
- CM: Firmware update and boot failure



RPM - reactive processing; TMM - thermal management;
CM - controls & electronics; PGM - power generation; PCM - power controls;
EESM - electrical energy storage; SM - structure

FIGURE 2. Failure Allocation

CONCLUSIONS AND FUTURE DIRECTIONS

- Permitting is a case-by-case situation. Working with the utility for one site host was a straightforward process provided that the application requirements were met. Working with the utility for the second site host has been extremely problematic and has caused very significant delays.
- It is difficult to project the timing requirements for permitting, therefore future direction is to start the permitting process as soon as possible in any project.

FY 2013 PUBLICATIONS/PRESENTATIONS

1. H2RA007_PETRECKY_2013_o (Annual Merit Review)