

VII.14 Accelerating Acceptance of Fuel Cell Backup Power Systems

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Subcontractor

IdaTech, Bend, OR

Project Start Date: June 2009

Project End Date: May 2014

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

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.

- 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
- Successful installation, commissioning, and decommissioning of the first fleet of 10 GenSys units at Site Host 2, resulting in the following metrics for backup power:
 - 15,187 operating hours
 - 15.6 MWe-hr electricity produced
- A network outage simulation occurred at Site Host 2 on April 8. The fuel cells powered the lighting in the building without issue.

Technical Targets and Milestones

- Install 20 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
- A network outage simulation occurred at Site Host 1 on January 19, 2013. The fuel cells powered the lighting in the building without issue. The commercial utility power was turned off and within ~20 s, the relays transferred and lighting was restored by fuel cell system power. Network outage simulation was roughly 30 minutes.



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 runtime of the GenSys system, extended backup is achieved, see Figure 1.



FIGURE 1. Approach

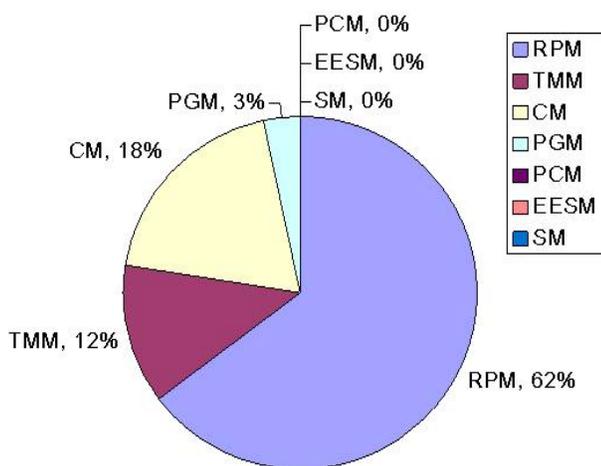
RESULTS

As outlined in the Accomplishment sections, the fleet of 10 GenSys units at Site Host 1 was successful in providing 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 (Figure 2):

- Reactive Processing: Anode tailgas oxidizer timeout waiting for catalyst activation
- Controls and Electronics: Electronic board failures, some possible connection to software.
- Reactive Processing: Loss of fuel flow (related to flow meter/valve issues)
- Thermal Management: Coolant leak, loss of coolant
- Reactive Processing: Anode air pump failed to start, known issue
- Reactive Processing: Gas leak during commissioning

Failure Allocation in DOE 7A Backup Power Systems (October 2011- Dec 31, 2011)



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

- Controls and Electronics: Unknown, attributed to electronic boards
- Reactive Processing: Fuel flow issue with occasional dropout or flow spikes
- Power Generation Module: Max low cell trips, stack protection due to either CO or cell performance
- Reactive Processing: Desulfurization needed excessive time for conditioning/equilibration.
- Controls and Electronics: Firmware update and boot failure

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.
- More charges may impact grid-parallel backup value propositions. Utilities are now charging a standby charge. The total line items of charges are as follows:
 - Customer Charge (flat)
 - Energy Charge—different rates for time of use (on peak, mid peak, off peak)
 - Demand Charge—related to the maximum amount of energy used
 - Standby Charge—“...represents the entire reserved capacity needed for SCE to serve the customer’s load regularly served by the customer’s generating facility when such facility experiences a partial or complete outage.”
- This Standby Charge will likely affect the value propositions for backup, intermittent, or potentially other alternative power sources by adding another charge to what is expected to be removed from the grid.

FY 2014 PUBLICATIONS/PRESENTATIONS

1. H2RA007_PETRECKY_2014_o (Annual Merit Review).