

XI.5 Jadoo Power Fuel Cell Demonstration

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Delphi Corporation, Troy, MI

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Objectives

- The development of two portable electrical generators in the 1,000 watt range utilizing solid oxide fuel cells (SOFCs) as the power element and propane as the fuel.
- The development and demonstration of a proof-of-concept electro-mechanical propane fuel interface that provides a user-friendly capability for managing propane fuel in a manner that supports the widespread adoption of fuel cells.
- The deployment and use of the fuel cell portable generators to power media production equipment over the course of several months at multiple high profile automobile racing events staged in multiple locations throughout the United States.
- The deployment and use of the fuel cell portable generators at scheduled events by first responders (police, fire) of the City of Folsom, California to power equipment in emergency and/or off-grid situations.
- Capturing data with regard to the systems' ability to meet DOE technical targets and evaluating the ease of use and potential barriers to further adoption of the systems.

Technical Barriers

- Reducing stack and balance of system to size allowing portability.
- Reliability of SOFC system under rough field conditions.
- User factors related to start-up times and refueling.
- Effectiveness/complexity of processing propane to remove sulfur.
- Potential constraints on type or source of propane.

This project addresses the following technical barriers from the Fuel Cells section of the Fuel Cell Technologies (FCT) Program Multi-Year Research, Development and Demonstration Plan:

- (A) Durability
- (C) Performance
- (E) System Thermal and Water Management
- (G) Start-up and Shut-down Time and Energy/Transient Operation

Relevance to ARRA

The Jadoo project will result in the saving of five to six jobs at Jadoo Power and Delphi Automotive. Longer term, the project will provide data in a high-profile environment to potential users of fuel cell generators, and hence will ultimately spur economic activity by promoting the procurement of more fuel cell generators for similar applications.

The project also is relevant to the DOE-FCT's ARRA project goals by accelerating the commercialization and deployment of fuel cells and fuel cell manufacturing, installation, maintenance and support services for these fuel cells.

Technical Targets

TABLE 1. Generator Performance Metrics

Metric	Target
Power (Continuous)	1,000 W
Efficiency (Peak)	30%
Noise	<62 dB
Start-Ups & Cycles	20
Operating Hours	2,000 hours each system

- Propane desulfurizer to reduce the level of sulfur in propane to less than 10 ppb for eight continuous hours.

- Propane fuel interface that can indicate the amount of propane within $\pm 10\%$ of the actual amount for the entire range from full to empty.



Approach

This project will develop and install two SOFC systems in “real world” portable generator applications in order to ascertain that applicability of fuel cell solutions with respect to operational requirements and constraints, portability, and ease of use. Data capture will be done with regard to the systems’ ability to meet DOE technical targets and potential barriers to further adoption of the systems.

Two portable generators will be developed by leveraging parallel work by Delphi related to the use of SOFCs in truck auxiliary power unit applications. Delphi SOFC technology will be modified and packaged for portable application with alternating current power capability. Delphi will develop a desulfurizer to allow use of commonly available propane as the fuel source. Delphi will also develop a reformer for commonly available propane fuel. Jadoo Power will develop an electromechanical fuel interface by leveraging prior learning from development of an interface between proton exchange membrane fuel cells and metal hydride canisters, used in both government and commercial applications. Both SOFC systems will have final validation at the Jadoo facility prior to initial deployment at the City of Folsom. The systems will then be deployed and transported between multiple National Association of Stock Car Racing events to evaluate ruggedness, portability and suitability for “real world” applications.

This project’s environmental and safety plans for both hydrogen and propane for both the Delphi site and the Jadoo site, in addition to the test sites, are presently under development and will be based on prior environmental and safety plans of both Delphi and Jadoo.

Accomplishments

- Analyzed drawbacks for police and fire agencies of utilization of gasoline-powered generators.
- Conducted site survey of National Association of Stock Car Racing event and gathered site-specific baseline load data on media equipment power requirements.
- Researched propane industry standards and practices for storage, transport, safety and measurement of propane fuel, including methods of propane fuel level measurement, tank designs and sizes.

- Compared various current industry technologies and methodologies for measurement of propane levels.
- Evaluated potential of applying existing technologies and methodologies to a portable SOFC propane fueling system.
- Determined potential factors that may relate to application requirements for portable fuel cell propane tank fuel level determination, operation and safety.
- Surveyed current fueling and fill status monitoring techniques, evaluated capabilities and drawbacks, and developed set of potential solutions for this application.
- Developed preliminary requirements for fuel interface.
- Developed generic requirements for a portable generator.
- Facility support of propane complete.
- Reformer testing has begun.
- Blue Rhino propane characterization test complete. Data currently being analyzed.
- Desulfurizer hardware for performance testing has been delivered and on schedule for test start.
- System start-up requirements have been evaluated.
- Fuel delivery system design 75% complete.
- An environmental and safety plan has been developed in its basic form, and will be expanded to provide coverage to all manufacturing and test sites.

Future Directions

- Requirements definition complete
- Applications specifications design review
- System design – generator
- System design – desulfurizer
- Demonstrate sulfur removal – less than 10 ppb for eight hours
- System design – propane fuel canister interface
- Build and test generators
- Build and test propane fuel canister interface
- Demonstrate state-of-fill performance at $\pm 10\%$
- Demonstrate generation of 1 kW for eight hours
- Deployment, demonstrations and field tests
- Follow up tests, analysis and report generation

FY 2010 Publications/Presentations

1. Presentation at the 2010 Hydrogen Program Annual Merit Review Meeting, Ken Vaughn.