

VI.A.4 Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project

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Partners:

Shell Hydrogen, LLC, Houston, TX
District of Columbia Department of Transportation,
Washington, D.C.
U.S. Environmental Protection Agency,
Washington, D.C.
U.S. Army, Ft. Belvoir, VA
Quantum Technologies, Inc., Irvine, CA
Viewpoint Systems Inc., Rochester, NY
NextEnergy, Detroit, MI

Start Date: October 1, 2004

Projected End Date: September 30, 2009

Objectives

- General Motors and energy partner Shell Hydrogen, LLC, are deploying a system of hydrogen fuel cell vehicles (FCVs) integrated with a hydrogen refueling infrastructure to operate under real world conditions
 - Demonstrate progressive generations of fuel cell system technology.
 - Demonstrate multiple approaches to hydrogen generation and delivery for vehicle refueling.
 - Collect and report operating data.

Past Year Objectives

- Obtain vehicle operators.
- Collect, analyze, report data from vehicles and refueling locations.
- Identify additional retail refueling sites.
- Achieve full operation at the Shell, Washington, D.C. Benning Road station for liquid and compressed hydrogen refueling.
- Identify site for maintenance facility in New York City metropolitan area.

Technical Barriers

This project addresses the following technical barriers from the Technology Validation section (3.5.4.2) of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- (A) Vehicles
- (B) Hydrogen Refueling Infrastructure
- (C) Maintenance and Training Facilities
- (D) Codes and Standards

Contribution to Achievement of DOE Technology Validation Milestones

This project will contribute to achievement of the following DOE Technology Validation R&D Milestones from the Technology Validation section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- Demonstrate fuel cell vehicles that achieve 50% higher fuel economy than gasoline vehicles.
- Demonstrate (on a vehicle) compressed and cryogenic storage tanks achieving the 2005 energy and mass density targets.
- Validate fuel cell demonstration durability of 1,000 hours by 2006.
- Validate vehicle refueling time of 5 minutes or less.
- Validate fuel cell vehicles with 250 mile range (by 2008), 2,000-hour fuel cell durability, and a hydrogen cost of \$3.00/gge (based on volume production) by 2009.
- Five stations and two maintenance facilities constructed with advanced sensor systems and operating procedures.

Accomplishments

General Motors has accomplished the following project milestones:

- Phase 1 HydroGen3 fuel cell vehicles have been deployed: six in Washington D.C. area, two in southern California.
 - Maintenance sites continue to be operational
 - Support personnel continue to receive technical and safety training as required
- Full operation at the nation's first retail liquid and compressed hydrogen refueling station at Benning Road, Washington, D.C. with functional visitor center.
- All compressed hydrogen fuel cell vehicles of the current fleet are equipped with 700 bar compressed hydrogen storage systems and are the first fuel cell vehicles to receive certification for using a 700 bar system.
- Several hundred first responders have received safety training.
- Partnering with the U.S. Environmental Protection Agency and the District of Columbia Dept. of Transportation (DDOT) for fleet operation of vehicles.
- Site selection underway for New York City metropolitan area and southern California retail refueling stations.
- Vehicles collect data according to NREL Data Reporting Templates by operating in driving demonstrations and refueling at the Shell Benning Road and Ft. Belvoir facilities.
- On-road data collection
 - Logbook data entry automated where possible.
- Chassis dynamometer testing
 - Data accuracy enhanced by installation of precision hydrogen massflow measurement equipment.
- NextEnergy Codes & Standards
 - Training presentation materials.
 - Completed final design changes to permitting experience and permitting authority databases based on stakeholder feedback.
 - Databases moved from design phase to build phase.
 - Developed outline and agenda for Codes & Standards annual conference.

Introduction

This project has been underway for approximately one and one half years, has completed the first year goals and made progress in support of the long term goals of the DOE's Technical Validation portion of the Hydrogen Program. General Motors has deployed eight of its commercially developed FCVs according to plan and is maintaining them with two maintenance and training centers. The vehicles are accumulating miles and generating data that are submitted according to the NREL Data Reporting Templates.

Our partner Shell Hydrogen is operating a retail hydrogen refueling station that GM FCVs and other companies' FCVs are using. In addition, GM can refuel at GM maintenance sites. Data from retail station operation, including refuelings, is recorded and submitted according to the NREL Data Reporting Templates. Hydrogen is trucked in from a central location and stored at the refueling station for dispensing.

Approach

General Motors will demonstrate fuel cell vehicles through deployment and testing a total of 40 FCVs in various terrains, driving conditions, and climates including cold weather. The project approach is to establish and install retail hydrogen stations for public refueling on the east and west coasts, as well as explore hydrogen generation/delivery options such as electrolysis. Service operations will support these fuel cell vehicles with personnel trained in maintenance, refueling, technical support and safety.

Report data required under the project is generated through on-road and dynamometer test data captured from the vehicles, as well as from the hydrogen infrastructure production and refueling operation data.

In addition to these efforts, NextEnergy will develop codes and standards permitting templates and a database of permitting experiences.

Results

Six Opel Zafira hydrogen fuel cell minivans were deployed in the Washington D.C. area along with two Opel Zafira compressed hydrogen fuel cell minivans in the southern California area. General Motors has successfully partnered with the U.S. Environmental Protection Agency and the District of Columbia Department of Transportation for fleet operation of these vehicles. Maintenance and training are ongoing at the U.S. Army Ft. Belvoir, VA and Quantum, Lake Forest facilities. Additional site selection in the New York City metropolitan and southern California areas are underway.

Key vehicle and infrastructure data generated and reported that support the milestones are stack durability, fuel economy and vehicle range, fuel cell system efficiency, maintenance and safety, and refueling rate.

Dynamometer testing of Phase 1 has been conducted at GM's Milford Proving Ground according to the DOE schedule. On-road data collection has been automated wherever possible, and accuracy has been enhanced by installation and calibration of precision hydrogen massflow measurement equipment.

Safety training was conducted for several hundred emergency first responders. Presentation materials were developed based partially on the California Fuel Cell Partnership (CaFCP) Emergency First Responder Training Program for Hydrogen Awareness and Safety Overview for Responders in addition to input from project partners and the State of Michigan Office of Fire Fighter Training. First responder hydrogen education was presented to the Michigan Arson Prevention Committee and Michigan Fire Inspectors Society.

Note: Data from this demonstration project is reported as part of the composite results presented in project report VI.G.1.

Conclusions and Future Directions

Future Work

- Continue to pursue new vehicle operators.
- Construct retail hydrogen refueling stations – New York City metropolitan area and southern California.
- Codes and standards permitting experience and permitting authority databases will be completed during Q2 2006 (NextEnergy) and data population to begin shortly after training is complete (GM/Shell).
- Maintenance and training facilities – additional site in the New York City metropolitan area
- Data Collection enhancements for range, durability and H_2/gge .

Putting in place a facility that contains hydrogen, no matter the quantity, is a unique experience that breaks new ground. Based on our experience and lessons learned to date, we are making the following recommendations:

- Develop credible third party hydrogen safety experts
 - Independent authority that is trained in media relations and that the local community will accept.
- Develop fire training roadshow
 - Self-contained trailer to move around the country.
 - Leverage refueling stations, maintenance sites and FCVs from DOE learning demo teams.
- Engage local government officials and urban planners in developing community enthusiasm for hydrogen
 - Focus on educational institutions and community organizations.

FY 2006 Publications/Presentations

Presentations/briefings

1. Executive Leadership Panel Summit, NextEnergy, Detroit – 10/05
2. State of International Platinum Association, Washington, D.C. – 9/05
3. Hydrogen Virginia Building Codes Conference, Norfolk, VA – 10/05
4. Fuel Cell Seminar, Palm Springs, CA – 11/05
5. Delegation Henan Province, China, Methanol Institute, Washington, D.C. – 11/05
6. Assoc. for Public Policy Analysis and Management, Washington, D.C. – 11/05
7. Hydrogen Fuel Cell Technology, Washington International School – 12/05
8. Johns Hopkins School of Advanced International Studies – 12/05
9. North Carolina State Univ. Transportation Research, Raleigh – 3/06
10. Stockholm Auto Show, Sweden – 3/06

Congressional Testimony

1. House Government Reform Committee – 7/05
2. Senate Energy Committee – 7/05
3. House Science Committee – 12/05