

VIII.10 Texas Hydrogen Highway*

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Subcontractors:

- University of Texas at Austin, Center for Electromechanics (UT-CEM), Austin, TX
- Gas Technology Institute (GTI), Sugar Land, TX, and Des Plaines, IL
- Houston Advanced Research Center (HARC), The Woodlands, TX

Project Start Date: September 1, 2008

Project End Date: September 1, 2010

*Congressionally directed project

(D) Maintenance and Training Facilities

(E) Codes and Standards

Contribution to Achievement of DOE Technology Validation Milestones

This project will contribute to achievement of the following DOE milestones from Section 3.6: Technology Validation of the Fuel Cell Technologies Program Multi-Year Research, Development and Demonstration Plan:

- Milestone 11: Decision to proceed with Phase 2 of the learning demonstration (2Q, 2010)
- Milestone 14: Validate achievement of a refueling time of 3 minutes or less for 5 kg of hydrogen at 5,000 psi using advanced communication technology. (2Q, 2012)
- Milestone 24: Validate a hydrogen cost of \$3.00/gge (based on volume production). (4Q, 2009)
- Milestone 25: Validate refueling site compression technology provided by the delivery team (4Q, 2012)
- Milestone 26: Validate refueling site stationary storage technology provided by the delivery team. (4Q, 2012)
- Milestone 32: Validate the ability to produce 5,000 psi hydrogen from natural gas for \$2.50/gge, untaxed and with large equipment production volumes (e.g. 500 units/year) for 1,000 hours. (3Q, 2011)

Objectives

- To advance commercialization of hydrogen-powered transit buses and supporting infrastructure.
- To provide public outreach and education by showcasing the operation of a 22-foot fuel cell hybrid shuttle bus and Texas's first hydrogen fueling infrastructure.
- To showcase operation of zero-emissions vehicle for potential transit applications.

Technical Barriers

This project addresses the following technical barriers from the Technology Validation section (3.6) of the Fuel Cell Technologies Program Multi-Year Research, Development and Demonstration Plan:

- (A) Lack of Fuel Cell Vehicle Performance and Durability Data
- (B) Hydrogen Storage
- (C) Lack of Hydrogen Refueling Infrastructure Performance and Availability Data

Approach

This project was originally developed in 2004 to show that a skid-mounted, fully-integrated, factory-built and tested hydrogen fueling station could help simplify and lower the cost of fueling infrastructure for fuel cell vehicles. The initial project approach was to design, engineer, build, and test the integrated fueling station at the "factory"; install it at a site that offered educational and technical resources; and provide an opportunity to showcase both the fueling station and advanced hydrogen vehicles. Through the five years of project development (2004 to 2008), in coordination with various public and private sector sponsors, the site selected for a fuel cell bus and fueling station was Austin, Texas. Project participants are using these hydrogen technology assets in this current project (Texas Hydrogen Highway) to inform Texas target audiences on hydrogen and fuel cell applications. The assets in Austin are illustrating the potential for commercialization of hydrogen-powered transit buses, fueling infrastructure and related technologies. The project also showcases

modeling techniques that can be used to design hydrogen vehicle and fueling solutions for other locations and applications.

The station and bus are housed at the J.J. Pickle Research Center, University of Texas at Austin located in north Austin (Figures 1 and 2). The hydrogen fueling station is operated by the University of Texas technical staff, under the supervision of GTI personnel. In addition to the fueling station, the project showcases a plug-in hybrid electric fuel cell transit bus that can operate in a real-world commercial application. It serves to validate the potential for transit agencies (and others) to operate similar vehicles thereby reducing emissions and the nation's dependency on foreign sources of energy for transportation fuels.

Accomplishments

- Commissioning of the fuel station in February 2010:
 - The project team expended considerable effort for start-up of the station in Austin.
 - Performance and safety checks were conducted on the system during initial start-up which resulted in resolution of the following issues:
 - Pressure fluctuations in the system during automated start-up have led to on-site adjustment of the system controls.
 - Communications network link problems at the University of Texas led to a station computer system crash and subsequent need to reprogram the hydrogen station automated controls.
 - The hydrogen station storage and dispensing system have been purged with hydrogen and test “fills” have been accomplished from the station to the fuel cell bus.
- Station commissioning trials were completed and hydrogen was generated on-site for use by the fuel



FIGURE 1. Fuel Cell Plug-in Hybrid Shuttle Bus, Austin, Texas



FIGURE 2. Hydrogen Fuel Station, Austin, Texas

- cell bus. All systems were deemed operational March 15, 2010.
- Completed and submitted fueling station safety plan to DOE.
- Held station showcase events for limited, invited visitors, which included bus rides and station tours.
- Conducted four Texas showcase events in Fall 2009 and early 2010 in coordination with various target groups. Conducted transit staff briefing and training in conjunction with these showcase events.
- Conducted briefing on the project for Texas legislative staff.
- Transit agency personnel from Capital Metropolitan Transportation Authority conducted interface meetings at both Capital Metro and UT-CEM to discuss hydrogen bus and fueling station operation and maintenance (March 24-25, 2010).
- Completed final Powertrain Systems Analysis Toolkit (PSAT, a vehicle simulation software package developed at Argonne National Laboratory) modeling of transit routes to verify vehicle suitability for deployment.
- Collaborated on fuel cell bus and electrified transportation modeling.
 - UT-CEM collaborated with the University of Texas Department of Mechanical Engineering and Georgia Tech on advanced energy storage and modeling techniques of electrified vehicles, including PSAT model development of the Ebus and studies of ultracapacitor assisted batteries.
 - UT-CEM assisted Georgia Tech on battery modeling method in PSAT for advanced, electrified transportation.
- Submitted grant request to Texas Commission on Environmental Quality to support hydrogen station operation as part of the U.S. Department of Transportation/Federal Transit Administration National Fuel Cell Bus Program, April 2010.

Future Directions

- Continue monitoring and evaluation of station and bus operations.
- Plan and conduct final outreach and showcase event in Austin with state and local government officials.
- Compile report on project milestones.

FY 2010 Publications/Presentations

1. February 24, 2010 at the Austin, Texas Hydrogen 101 Workshop. “There is a Hydrogen Fuel Cell Bus Operating in Texas” (R. Thompson, UT-CEM) and “Hydrogen Infrastructure 101”, (B. Weeks, GTI).
2. Hydrogen Infrastructure. (B. Weeks, GTI). Presentation at the Gulf Coast Chapter of the American Institute of Chemical Engineers, Houston, Texas, March 2010.
3. Abstract accepted for oral presentation on project at 2010 Annual Fuel Cell Seminar, San Antonio, Texas, October 2010.