

VIII.A Vehicle Demonstrations

VIII.A.1 Hydrogen to the Highways

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Contract Number: DE-FC36-04GO14285

Subcontractors:

DaimlerChrysler AG, Stuttgart, Germany

BP America, Warrenville, IL

Mercedes Benz USA LLC, Montvale, NJ

DTE Energy, Detroit, MI

NextEnergy, Detroit, MI

Start Date: December 22, 2004

Projected End Date: December 22, 2009

Objectives

- Record, collect, report, and analyze data from fuel cell vehicles (FCVs) and hydrogen fueling operations
- Validate 2009 performance targets
 - Fuel cell stack durability: 2000 hours
 - Vehicle range: 250+ miles
 - Hydrogen cost at the station: \$3.00/gge
- Demonstrate the safe installation of hydrogen fueling stations, fuel cell maintenance and service facilities, and the safe operation of all fuel cell vehicles
- BP:
 - Establish an initial hydrogen infrastructure network to fuel small fleets of fuel cell vehicles across a metropolitan area
 - Develop retail compatible hydrogen refueling systems
 - Evaluate emerging hydrogen technologies that have the ability to meet DOE cost and performance targets
 - Explore cost and commercial feasibility of renewable-based hydrogen generation

Technical Barriers

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

- A. Vehicles
- B. Storage
- C. Hydrogen Refueling Infrastructure
- D. Maintenance and Training Facilities
- E. Codes and Standards
- H. Hydrogen from Renewable Sources

Contribution to Achievement of DOE Technology Validation Milestones

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

Milestone 1: Make awards to start fuel cell vehicle/infrastructure demonstration activity and for hydrogen co-production infrastructure facilities.

Although the contract for this project was not signed until December 22nd, 2004, DaimlerChrysler began deploying fuel cell vehicles to customers in the United States in February, 2004. The energy partners, DTE and BP, also initiated the construction of the hydrogen infrastructure before this demonstration project began. The DTE/BP station opened in October, 2004, and BP made two additional stations (Los Angeles International Airport and California Fuel Cell Partnership) available for vehicles within the DOE project without the financial support of DOE funding.

Milestone 2: Demonstrate FCVs that achieve 50% higher fuel economy than gasoline vehicles.

DaimlerChrysler currently has 22 fuel cell vehicles in the United States. The preliminary data of individual vehicles show a range of 50 to 78.4 mpg fuel economy depending on drive cycles, customer handling, climate, and other factors. More relevant and comprehensive data is expected to be reported when more mileage has been accumulated in customer operation.

Milestone 3: Demonstrate (on a vehicle) compressed and cryogenic storage tanks achieving the 2005 energy and mass density targets.

The compressed hydrogen storage tank (5000 psi) that is used in both the F-Cell and Sprinter fuel cell vehicles realizes an energy density of 0.58 kWh/l.

Milestone 5: Validate fuel cell demonstration vehicle range of ~200 miles and durability of ~1,000 hours.

To date, the F-Cell passenger vehicle has demonstrated a driving range of up to 100 miles, and the Sprinter light-duty delivery van has demonstrated a driving range of up to 106 miles. Due to continued improvements and upgrades, this range is expected to increase. Various factors for the next generation of vehicles will influence and improve the performance, range and durability. Moving forward in our technologies, improved packaging, increased efficiencies, and other anticipated advancements will extend the range beyond the targeted specifications. Continued evaluation of durability will be addressed throughout the project.

Milestone 6: Validate vehicle refueling time of 5 minutes or less.

Due to regular use by customers, the fuel cell vehicles are being refueled on a consistent basis at a variety of fueling stations. Various technologies are being tested and demonstrated throughout the infrastructure network, and results are reported within the project. This will support the continued improvement of refueling time. The permanent station utilizing electrolysis at the DTE/BP station in Southfield, Michigan currently provides an average refueling time of less than 10 minutes. For consistent and customer-friendly operation, a target of less than 3 minutes is essential. With new technologies, including pre-cooling and proper communication between the vehicle and fueling station, the overall refueling time can be significantly reduced.

Milestone 9: Validate FCVs with 250-mile range, 2,000-hour fuel cell durability, and a hydrogen cost of \$3.00/gge (based on volume production).

DaimlerChrysler, through its continued innovation and product improvement, is developing future generations of fuel cell vehicles that will meet or exceed the 2009 performance targets. The data acquired from the fuel cell Sprinter and F-Cell vehicles directly contribute to the upgrades and improvements to the fuel cell vehicle system. BP, through its continuing and future testing of technologies, is developing the necessary tools to understand how the hydrogen cost target can be achieved economically and efficiently.

Milestone 11: Validate cost of producing hydrogen in quantity of \$3.00/gge untaxed.

BP, through its continuing and future testing of technologies, is developing the necessary tools to understand how the hydrogen cost target can be achieved economically and efficiently. BP is assessing with its suppliers several technologies to understand their current status and potential of meeting the \$3.00/gge target untaxed by 2008. The following is a list of a few of the technologies reviewed to date: H2Gen 2000, Idatech Combined Heat and Power technology, Air Products Harvester, Proton Energy High Pressure PEM System with Electrochemical Compression, and GE Autothermal Reformer.

Milestone 12: Five stations and two maintenance facilities constructed with advanced sensor systems and operating procedures.

As mentioned in the Statement of Work, "The three regions (of vehicle distribution) will be supported by regional service facilities, with all the tools, equipment, and service infrastructure required for maintenance of the fleet. Fueling stations will be located in each region." DaimlerChrysler is constructing three service stations, one for each of the three geographical areas (Northern California, Southern California, and Southeast Michigan). Detailed safety procedures and precautions have been implemented from the initial design to the continued operations. Maintenance facilities are currently undergoing simulation modeling exercises and will be upgraded with the appropriate sensors and safety equipment as needed. Energy partners DTE and BP have constructed and are operating a fueling station in Michigan utilizing the highest standards of safety and precautionary systems. The planning and design of all upcoming permanent hydrogen stations, as well as mobile refuelers, will continue to utilize these safety standards.

- Besides the DTE station, BP is progressing work on the following:
 - The NextEnergy station is on target for opening by 4Q 2005. NextEnergy is progressing on planning and zoning documentation. Permit and design documentation is being prepared for submission.
 - The San Francisco Mobile station is on target for opening in 4Q 2005. BP is working with the local site owner to finalize the lease agreement. After that, local permitting will start.
 - Site selection for the San Francisco and Los Angeles permanent stations is in progress.

Approach

DaimlerChrysler will deploy and operate 30 fuel cell vehicles in three different ecosystems within the United States. The three ecosystems represent a range of climates and include Southeast Michigan (cold climate), Northern California (mild climate), and Southern California (warm climate) (see Figure 1). These vehicles will maintain continued customer operation and will be utilized in day-to-day operation in various driving patterns.

The energy partners – BP, DTE, and NextEnergy – plan to install the necessary infrastructure to support the vehicles in each geographical area (see Figure 1) and evaluate the technologies which have the potential to achieve the U.S. DOE hydrogen cost targets.

The 28 F-Cells and 2 fuel cell Sprinters utilize a 72-kW (97-hp) fuel cell system fueled by 350-bar (5000-psi) compressed hydrogen. The traction battery system is a 6.5 Ah nickel metal hydride module which is air cooled. All of the vehicles within the DOE demonstration project will be equipped with a customer-friendly Fleet Data Acquisition (FDA) system that will automatically collect statistically relevant data for submission to the National Renewable Energy Laboratory as well as for engineering analysis for technology improvement. DaimlerChrysler’s goal is to create a broad database to evaluate the status quo of fuel cell vehicles and hydrogen as a transportation alternative fuel.

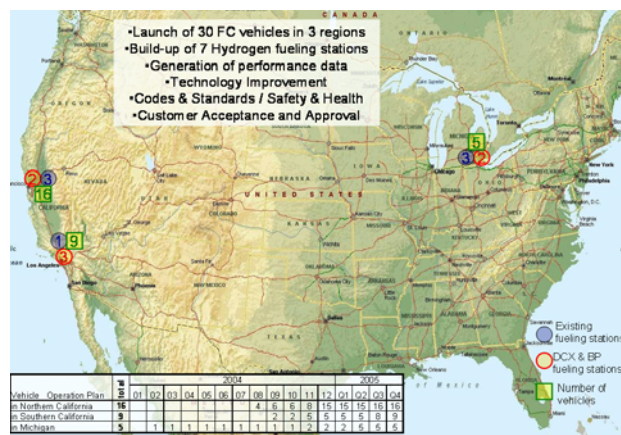


Figure 1. Vehicle Operation Plan