

VIII.7 Vermont Renewable Hydrogen Production and Transportation Fueling System (New Project)*

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Subcontractor: Proton Energy Systems, Wallingford, CT

** Congressionally directed project.*

Objectives

- Develop advanced proton exchange membrane (PEM) electrolysis fueling station that utilizes renewable electricity sources
- Reduce cost of hydrogen production
- Improve electrolyzer efficiency
- Improve fueling station integration and controls
- Utilize hydrogen-fueled vehicles for testing and validation
- Show viability of distributed production pathway

Technical Barriers

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

- Q. Cost
- R. System Efficiency
- S. Grid Electricity Emissions
- T. Renewable Integration

Approach

Purpose

Develop advanced PEM electrolysis fueling station technology. Build and test a validation system in Vermont that utilizes renewable electricity and is capable of providing hydrogen fuel to vehicles. Procure, operate, and maintain a hydrogen-fueled vehicle for testing and validation of the station.

Scope

This project will contribute to numerous R&D objectives of the Hydrogen Program and will also help reduce technical barriers in key areas. Goals of the project include reduced cost of hydrogen production, improved electrolyzer efficiency, improved on-board hydrogen storage system, advanced systems integration and controls, technology validation, hydrogen production from domestic renewable energy sources (specifically wind power), and validation of the distributed production pathway. This project will push the technology towards the DOE targets of \$2.50/kg hydrogen from electrolysis and electrolyzer capital cost of \$300/kWe for 250 kg/day production at 5,000 psi with 73% system efficiency.

The fueling station will include an advanced Proton HOGEN H Series electrolyzer (12 kg/day, 40 kW at peak production capacity) with a combination of electrochemical and mechanical compression for on-site storage at 6,000 psi in high-pressure cylinders. The preferred dispensing system will have a unique dual functionality configuration, being able to provide hydrogen fuel to an advanced metal hydride storage system that will be located onboard a hydrogen vehicle or provide hydrogen for vehicles that use 5,000 psi tanks. The Air Products Series 200 hydrogen fueling package, or a comparable offering that provides the compression, storage, and 5,000 psi dispensing, will be modified to provide the dual dispensing functionality.

The electrolyzer will validate numerous efficiency and cost reduction concepts including advanced cell stacks designed for reduced cost and improved performance, advanced power electronics that will improve controls functionality and efficiency, new packaging concepts for outdoor rating and reduced cost of manufacturing, and controls and packaging for H Series in fueling station applications. (H Series was designed primarily for the industrial gas market, so this will be a new application for this product.) Electrochemical compression at higher pressures and new driers that will reduce the efficiency losses required for the removal of moisture from the product gas may also be evaluated. These aspects will not be validated for this project, but design concepts, technical hurdles, and a product integration path will be clearly identified for future systems.

A hydrogen-fueled passenger vehicle with state-of-the-art onboard hydrogen storage is envisioned for this project. Currently, the preferred vehicle is a Toyota hybrid Prius, which will be converted by Texaco-Ovonics to operate using hydrogen fuel in the internal combustion engine and will utilize an advanced metal hydride on-board storage system. If this vehicle is selected, reporting will include a comparison of the published performance of various types of hydride storage and compressed gas storage versus the real world data collected while operating the vehicle during this project. Final vehicle selection is part of the initial task.

EVERmont will contract with Northern Power Systems and Proton Energy Systems to design, build, and test the system. Northern will provide project management, systems integration, and renewables expertise. Proton will provide the electrolyzer system and hydrogen expertise.

Background

EVERmont, started in 1993 by then governor Howard Dean, is a public-private partnership of entities interested in documenting and advancing the performance of advanced technology vehicles that are sustainable and less burdensome on the environment, especially in areas of cold climates, hilly terrain and with rural settlement patterns.

EVERmont is the recipient of the DOE financial assistance award for the project. This project will be a combination of R&D (20% cost share) and demonstration (50% cost share). The fueling station components are R&D and the vehicle components are demonstration.

Constraints

This will be the first hydrogen fueling facility in Vermont. The budget, the limited availability of hydrogen-fueled vehicles, the lack of existing guidelines for hydrogen fueling and hydrogen vehicles in Vermont, the accessibility to renewable energy sources, and the limited number of appropriate host sites and fleet vehicle users are all constraints for this project. There are viable alternatives or solutions for each of these challenges, and none of these factors are considered barriers to success, but each provides added complexity to validation.

Tasks

- Task 1 – Project Planning
- Task 2 – System Design and Engineering
- Task 3 – Fabrication and In-house Testing
- Task 4 – Installation and Commissioning
- Task 5 – Testing, Monitoring, Analysis, Reporting

The proposed work covers a 3-year period. Planning, design, and fabrication are scheduled for 2004; the hydrogen fueling system installation and vehicle procurement are planned for early 2005, followed by 1 year of applied research and development, finishing with a final report in summer 2006.