# V.D.7 Hydrogen Filling Station*

*Robert Boehm (Primary Contact), Janice Wiedeman, Thomas Maloney*
*University of Nevada Las Vegas*
*Center for Energy Research*
*UNLV Box 454027*
*Las Vegas, NV 89154-4027*
*Phone: (702) 895-4160; Fax: (702) 895-3936; E-mail: boehm@me.unlv.edu*

*DOE Technology Development Manager: Sig Gronich*
*Phone: (202) 586-1623; Fax: (202)586-9811; E-mail: Sigmund.Gronich@ee.doe.gov*

*Subcontractors:*
*Proton Energy Systems, Wallingford, CT*

**Congressionally directed project*

## Objectives

Design, install and analyze operation of a hydrogen fueling system utilizing solar power

- Define the fueling system requirements
- Design the layout for the fueling system
- Meet with possible hosts and screen a number of potential fueling station locations
- Select the fueling station site, layout the site plan, and obtain appropriate permits
- Monitor operation of the fueling system and characterize the performance

## 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:

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

## Approach

- Establish fueling system requirements
  - Determine hydrogen production/storage requirements for system
  - Determine utility requirements for the system
- Select fueling station site
  - Identify and assess candidate host sites
  - Selecte site with adequate utilities and owner commitment
  - Initiate inspection approval procedures and permitting process
- Complete fueling system design and layout
- Conduct in-house testing of the fueling system
- Install, operate, and analyze performance of fueling system at site

## Accomplishments

- Assessed nine candidate sites and made final selection
- Secured NEPA approval for the site
- Completed the fueling station site plan
- Completed conceptual design for the fueling station
- Determined optimal ways of interfacing with solar photo-voltaics (PV)
- Examined potential uses of oxygen product

## Future Directions

- Complete the permitting process with local permitting authorities
- Complete final design of the fueling system
- Conduct in-house testing of the fueling system
- Set up remote performance monitoring system
- Install, operate and analyze performance of the fueling system
- Plan for the development of hydrogen-fueled vehicle availability

---

## Introduction

Hydrogen can be a desirable fuel for transportation applications because, when used in fuel cell vehicles, it creates no emissions other than water vapor. In order to truly realize the zero emission attributes, it is desirable to obtain the hydrogen fuel from processes which do not generate harmful emissions. One of these processes is solar-powered water electrolysis. There are cost, efficiency, and system integration challenges associated with solar electrolysis systems for fueling application. In this project, system integration challenges will be met and system efficiency will be measured during operation. Later work will focus on development of more efficient approaches as well as hydrogen-fueled vehicles.

## Approach

The goal is to install, operate, and analyze performance of a PEM electrolysis based fueling system that utilizes solar energy. The tasks required to meet the goal include the following:

1. Survey a large number of potential host sites through meetings with high administration officials at each.
2. Identify the site to be used, primarily on host enthusiasm and ability to support the site in the long term.
3. Prepare all necessary background materials needed for permitting the selected site.
4. Prepare the site.
5. Develop a safety plan for the project (see Table 1).
6. Design and test the system.
7. Install the system and a remotely connected data acquisition system.
8. Operate the system at the site.
9. Analyze performance of the system.

**Table 1.** Project Safety Concerns and Approaches to Them

| Potential Safety Concerns | Safety Precautions |
|---|---|
| Hydrogen Leaks | Proper (approved) Component Selection |
| Storage of 430 bar compressed $H_2$ | Leak Testing, CG Sensors & Shut Down Systems |
| Explosion/Detonation | $H_2$ dilution; use of X-Proof Components |
| Dispensing $H_2$ into Vehicles | Follow established procedures (SAE, CaFCP) |
| Appropriate codes and standards | (NFPA 50A, NFPA 52, NFPA 70, ASME, NFPA 496) |
| General Issues | Proper Training for Operation, Maintenance, Emergency Response |

**Figure 1.** Site of planned hydrogen refueling station at the Las Vegas Valley Water District near the intersection of Charleston and Valley View in Las Vegas, Nevada. This is adjacent to a compressed natural gas filling station.

## Results

### *Site identified*

After screening nine candidate sites, the Las Vegas Valley Water District was selected as the host. Several criteria were used for site selection including the enthusiasm for being involved with the project, ability and interest in applying cost share, the ability to develop hydrogen utilization pathways, and the opportunity for us to continue to use the site for further developments. The site selected already has a natural gas fueling station in operation. The NEPA environmental approval process was completed for the selected site and the permitting process was initiated.

### *Designing and testing the system*

The overall system layout and site plan have been completed and the major components (with the exception of the PV system) have been placed on order. The outdoor enclosure has been designed, as has the water supply subsystem. The integration plan for connecting the hydrogen generator to the high pressure hydrogen compression, storage, and dispensing subsystem has been devised. Preparation of the in-house test site has been initiated.

### *PV studies*

Computations have quantified how the output of various sized PV panels can supplement the electricity required for the hydrogen production and compression. The Water District has agreed to consider purchase the PV panels for this filling station along with a large system they are acquiring. We are awaiting the outcome of that decision.

## Conclusions

A large number of organizations in Las Vegas have shown significant interest in hydrogen generation and use, but their progress has been hampered by a severe lack of knowledge about how to develop the needed infrastructure. This project can serve as a model for future development of renewably-generated hydrogen and its utilization in vehicles. The breaking down of knowledge gaps and key barriers related to permitting and other aspects are being addressed in this work.

## FY 2004 Publications/Presentations

1. “Renewable Hydrogen Fueling Station”, Poster Presentation at the 2004 DOE Program Review, May 2004