MCBH "Fast Fill" Hydrogen Station

Hawai'i Natural Energy Institute

The Hawai'i Natural Energy Institute (HNEI) is conducting research to assess the technical performance and economic value of an electrolyzer based hydrogen production system in a 350/700 bar "fast-fill" fueling station located at Marine Corps Base Hawai'i (MCBH). This system supports a fleet of General Motors Equinox Fuel Cell Electric Vehicles (FCEV) operated by military personnel.

Figure 1. First Fill November 2014

Challenges & Significance

A major challenge for hydrogen production and dispensing stations is the cost of hydrogen at the nozzle. In order to displace fossil fuels hydrogen must be economically competitive with other transportation options. Light duty vehicles have largely been designed to use high pressure (700 bar) hydrogen storage while most larger fleet vehicles use a lower pressure (350 bar) system. The primary objective of this project is to evaluate the technical performance of the system components including the electrolyzer, compressor, storage system, and the refrigeration and dispensing systems and to assess the economic performance of each in terms of the cost of hydrogen delivered at the fueling nozzle for both high and low pressure operation. A secondary objective is to support the operation of a fleet of General Motors FCEV Equinox vehicles operated by military personnel. This project provides the opportunity to quantify these costs and identify pathways to reduce them to be competitive with other transportation technologies.

Status & Accomplishments

- Developed and executed legal agreements between University of Hawai'i and MCBH.
- Procured a dual, 350/700 bar hydrogen production/dispensing system.
- Installed and commissioned the fueling station at MCBH meeting all base facility, security, and safety requirements.
- Conducted US DOE Hydrogen Safety Panel and independent third party safety reviews of the equipment and site.
- Commissioned and operated the first licensed hydrogen transport trailer in Hawai'i to transport hydrogen between bases.
- Developed and installed a high-speed data acquisition system to measure dynamic performance of the system.
- Demonstrated well-controlled, repeatable, 4 minute high-pressure fast fills (over 60 between Nov 2014 and Jan 2015).

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Period of Performance:

2009 -2015

Partner(s):

- Marine Corps Base Hawai'i
- Powertech Labs, Inc

Funding:

- Office of Naval Research
- US Department of Energy
- State of Hawai'i

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Project Detail

The MCBH fast-fill hydrogen station is part of the Hawai'i Hydrogen Power Park project established by HNEI to support the US Department of Energy's (US DOE's) Technology Validation Program. Originally intended as a low-pressure fueling station to support the Hawai'i Volcanoes National Park (HAVO) hydrogen buses, the scope was expanded in 2011 to include 700 bar "fast fill" (under 5 minutes) capability to support the Equinox FCEV demonstration at MCBH on O'ahu.

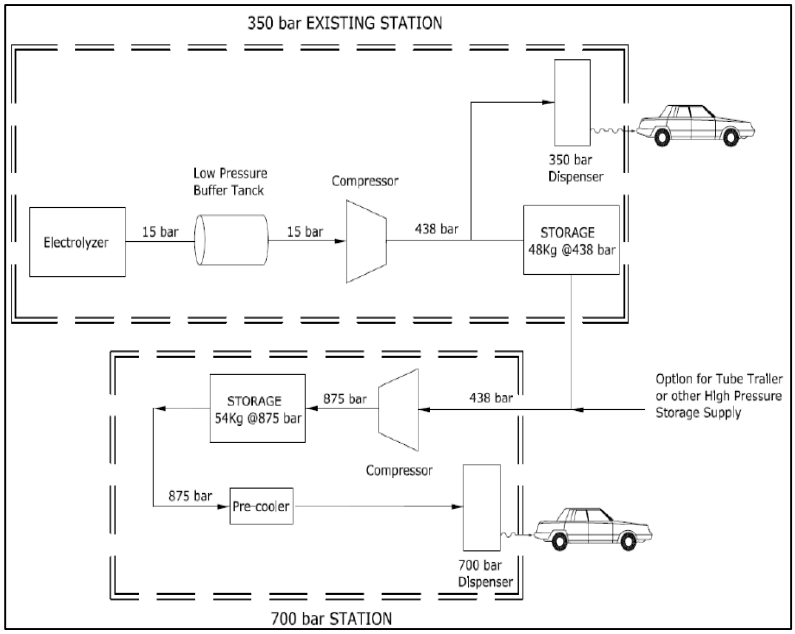

Figure 2. Fast-Fill Hydrogen Fueling Station Design

The system is comprised of parallel 350 bar and 700 bar dispensing stations integrated to take advantage of common production, storage, and compression (Figure 2). The 12 kg per day Proton HOGEN PEM electrolyzer produces hydrogen at 15 bar. A HydroPac compressor increases the hydrogen pressure to 438 bar for storage in a bank of Dynatek composite tanks (48 kg capacity) feeding the 350 bar dispenser. Hydrogen from the lower pressure system is further compressed to 875 bar at a maximum rate of 5.5 kg/hour to supply the high pressure dispenser. The second bank of Dynatek tanks has a capacity of 54 kg hydrogen. For high-pressure fast fill, the hydrogen is precooled to -20°C allowing 3 consecutive 700 bar fills.

A data logging system monitors and stores daily operating data. A framework has been developed to conduct a comprehensive technical and economic evaluation of the hydrogen production and dispensing. The technical analysis will include component efficiencies under various operating scenarios and the long-term durability of major components. The economic analysis will determine the daily operating cost of the station and the overall cost benefits of producing hydrogen.

Major challenges experienced in the project included:

- Legal agreements took over 2.5 years to resolve highlighting one of the major barriers to implementation of hydrogen fueling stations shared by similar projects.
- Installing an upgraded power supply that involved replacing the existing 300 KVA transformer with a 500 KVA transformer extended the schedule and added a significant cost escalation.
- Commissioning time was longer than expected due to technical issues with equipment and need to eliminate trace contamination of the hydrogen supply to meet SAE fueling standards.

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