
VII.12 CSULA Hydrogen Refueling Facility Performance Evaluation and Optimization

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Subcontractor
Hydrogenics, Mississauga, ON, Canada

Project Start Date: October 1, 2012
Project End Date: December 31, 2016

Overall Objectives

Technical Objectives:

- Test, collect data, and validate hydrogen refueling architecture deployed at CSULA and its individual components in a real-world operating environment
- Provide the performance evaluations data to the National Fuel Cell Technology Evaluation Center (NFCTEC) at the National Renewable Energy Laboratory (NREL)
- Contribute to the development of new industry standards
- Develop and implement fueling station system performance optimization

Educational Objectives:

- Conduct outreach and training activities promoting the project and hydrogen and fuel cell technologies
- Provide a living-lab environment for engineering and technology students pursuing interests in hydrogen and fuel cell technologies

Fiscal Year (FY) 2015 Objectives

- Perform regular collection of station performance data and submit quarterly reports to NREL
- Conduct outreach and training activities for public and government and engage students in station related activities

Technical Barriers

This project addresses the following technical barriers from the Hydrogen Production and Technology Validation sections of the Fuel Cell Technologies Office Multi-Year Research, Development, and Demonstration Plan:

Hydrogen Production

- (L) Operations and Maintenance
- (M) Control and Safety

Technology Validation

- (D) Lack of Hydrogen Refueling Infrastructure Performance and Availability Data

Contribution to Achievement of DOE Hydrogen Production and Technology Validation Milestones

This project will contribute to achievement of the following DOE milestones from the Hydrogen Production and Technology Validation sections of the Fuel Cell Technologies Office Multi-Year Research, Development, and Demonstration Plan:

Hydrogen Production:

- Milestone 2.6: Verify the total capital investment for a distributed electrolysis system against the 2015 targets using H2A. (Q2, 2016)
- Milestone 2.7: Verify 2015 distributed hydrogen production levelized cost target through pilot scale testing coupled with H2A analysis to project economies of scale cost reduction. (Q3, 2017)

Technology Validation:

- Milestone 3.4: Validate station compression technology provided by delivery team. (4Q, 2018)

FY 2015 Accomplishments

This is the first year of the project. Accomplishments are listed below.

- The station continues to collect and regularly submit performance data to NREL. Station utilization is steadily increasing with over 500 successful fills.
- CSULA became the first station in the United States to receive a seal of approval for commercial sales of hydrogen on a per kilogram basis.

- In addition to fueling light-duty vehicles, the station has also been used to fuel a bus, a mobile refueler, and a mobile fuel cell light source.
- CSULA has performed physical and programming upgrades toward improving safety, meeting fueling standards and per NREL data collection requirements.
- The station has had a steady flow of visitors learning about hydrogen (over 4,000 visitors since May 2014). In addition, three engineering students are interning at the station.



INTRODUCTION

The CSULA hydrogen station deploys the latest technologies with the capacity to produce and dispense 60 kg/d, sufficient to fuel 15–20 vehicles. The station utilizes a Hydrogenics electrolyzer, first and second stage compressors enabling 350 bar and 700 bar fueling, and 60 kg of hydrogen storage. The station is grid-tied and to be supplied by 100% renewable power.

In addition to collecting data per NREL specifications, the comprehensive data collection enhances research opportunities in evaluating and optimizing performance of the hydrogen fueling facility.

APPROACH

To enable effective data collection on the station performance, the team deploys significant number of sensors and meters installed on the station. A custom designed software package is utilized for data collection and reporting to NREL.

As data are collected and analyzed, the station hardware and software is gradually upgraded for optimization and other technical/safety enhancements.

RESULTS

Since its opening in May 2014 CSULA has secured fueling agreements with Hyundai, General Motors, and Volkswagen, providing steady increase in station utilization with more than 500 successful fills, see Figure 1.

Most of the individual equipment is power metered allowing further research into performance efficiency not only of the entire facility but also components. This enables steady data collection and submission to NREL. For example, Figure 2 presents hydrogen cost based on the station energy consumption. In addition, station hardware and programming has been updated to further enhance NREL reporting and improve station safety and compliance with fueling standards.

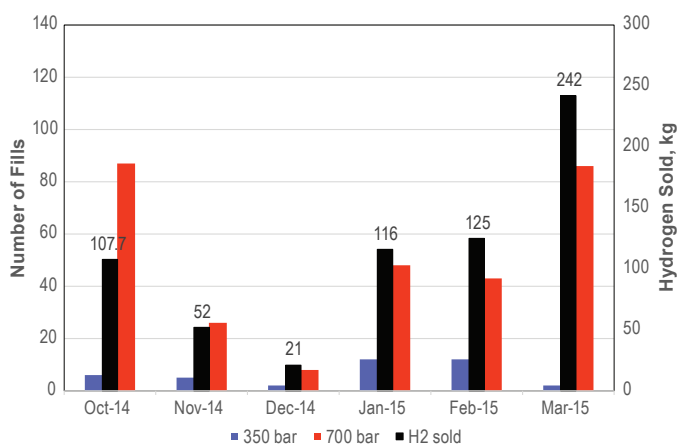


FIGURE 1. CSULA fueling events monthly

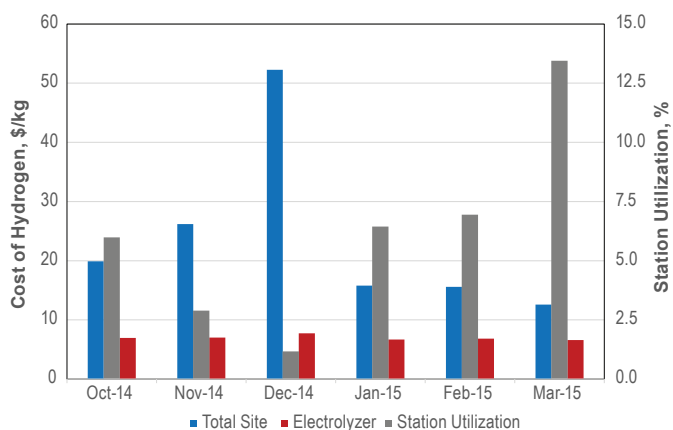


FIGURE 2. Hydrogen costs based on station energy consumption

CSULA became the first station in the United States to receive a seal of approval for commercial sales of hydrogen on a per kilogram basis in January 2015, see Figure 3. Two-phase testing a few months apart was conducted in collaboration with the California Division of Measurement Standards, the California Fuel Cell Partnership, and the California Air Resources Board. This will also enable point of sale using credit cards by individual drivers vs. original equipment manufacturer fueling contracts.

The station has been supporting outreach and collaborative efforts. More than 4,000 visitors have toured the facility with about 85% of them being K–12 and university students. Additionally, CSULA hosted professional meetings and first responder trainings. The facility has accommodated fueling of a bus, see Figure 4, mobile cell tower refueler, and mobile fuel cell lighting unit. The Volkswagen and Audi fuel cell vehicles were fueled during the press days of the Los Angeles Auto Show.



FIGURE 3. CSULA is being tested on the meter accuracy



FIGURE 4. E-bus is fueled at CSULA

CONCLUSIONS AND FUTURE DIRECTIONS

The project has completed Phase I and has transitioned in to Phase II. The station provides reliable fueling experience and generates data that are furnished to NREL. In collaboration with partners, CSULA has received funding from the California Energy Commission to secure two fuel cell shuttles to operate on campus.

SPECIAL RECOGNITIONS & AWARDS

1. Sustainable Transportation Award by 2015 UC and CSU Energy Efficiency and Sustainable Practice Awards Competition. CA Higher Education Sustainability Conference, San Francisco, CA, 2015.

FY 2015 PUBLICATIONS/PRESENTATIONS

1. "An Emerging Culture: Hydrogen Fuel Cell Use in East Los Angeles," C. Ney, D. Blekhman, and M. Dray. CA Higher Education Sustainability Conference, San Francisco, CA, 2015.
2. "Hydrogen Station Performance Evaluation Plan," D. Blekhman, M. Dray and G. Sleiman. Fuel Cell Seminar and Exposition, Los Angeles, CA, 2014.