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## VII.B.4 CSULA Hydrogen Refueling Facility Performance Evaluation and Optimization

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Hydrogenics, Mississauga, ON, Canada

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Project End Date: June 30, 2017

### 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 Hydrogen Secure Data Center 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) 2016 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.

- Review station performance based on data collected, identify potential areas for optimization, and implement if within budget.

### Technical Barriers

This project addresses the following technical barriers from the Fuel Cell Technologies Program 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 section of the Fuel Cell Technologies Program 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 2016 Accomplishments

- The station continues to collect and regularly submit performance data to NREL.
- CSULA recertified its state approval for commercial sale of hydrogen on a per kilogram basis.
- The station has collaborated with Sandia National Laboratories, NREL, and California Air Resources

Board to test the performance of DOE sponsored HyStEP device after its arrival to California.

- CSULA has performed physical and programming upgrades toward improving safety, meeting fueling standards and per NREL data collection.
- The station has had a steady flow of visitors learning about hydrogen. In addition, several engineering students are interning at the station. Former interns have secured jobs in the hydrogen field.



## 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 with certified 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. The facility is actively engaged in research projects and demonstrations to speed up the development of hydrogen infrastructure. As an educational institution, CSULA actively promotes the technology to various audiences and prepares students with a background in fuel cell and hydrogen applications.

## APPROACH

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

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

## RESULTS

Over the past year, CSULA has regularly submitted NREL quarterly reports on the station performance and hydrogen purity according to the contract with DOE. The reports have

been generated automatically using power, temperature, pressure, and mass flow meters. Based on NREL feedback, supplementary reporting on the daily stored amount of hydrogen has been implemented. Based on the observed performance and industry feedback, the station hardware and programming has been updated to improve station safety and compliance with fueling standards. In particular, up to three safety leak tests were added, fueling pressure corridors were implemented to meet 2014 SAE J2601, and the hydrogen chiller was adjusted from  $-24^{\circ}\text{C}$  down to  $-32^{\circ}\text{C}$ . The station availability has been improved by addressing valve leaking in the dispenser. The main flow valve was upgraded by its manufacturer, TESCOM, based on the station staff feedback and the weeping holes from this and another valve were routed externally to the dispenser.

In 2015, 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 2016, the station passed annual recertification. During testing the flow meter was recalibrated to meet the accuracy requirements. A point of sale credit card reader has been installed in the control room enabling commercial sales in addition to original equipment manufacturer contracts.

The station has been supporting outreach and collaborative research efforts. In September 2015 CSULA hosted a training workshop and a shake-down testing of the HyStEP device designed by NREL and Sandia National Laboratories, Figure 1. Sponsored by DOE, HyStEP is designed to test new stations to comply with 2014 fueling protocols. CSULA has used this opportunity to identify potential areas for improvement.

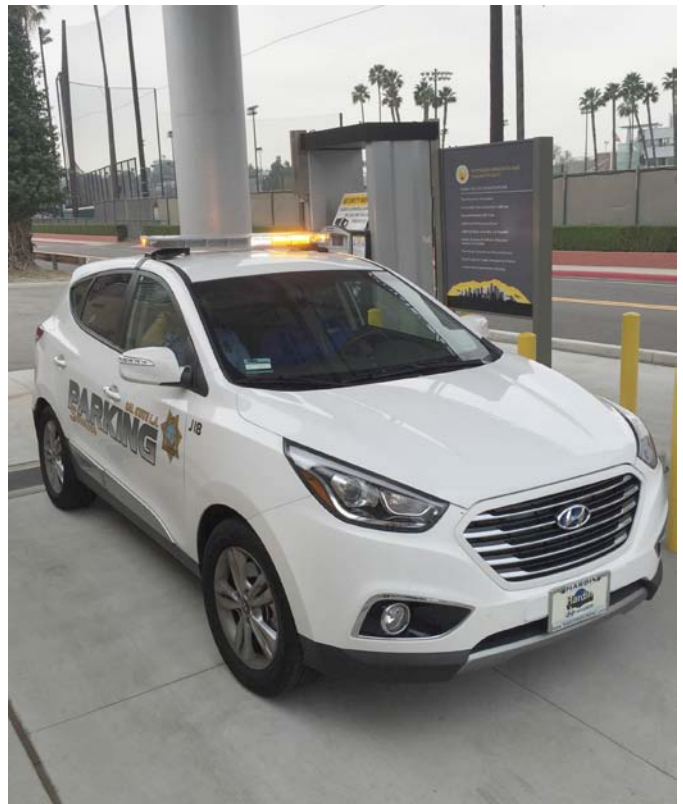


**FIGURE 1.** HyStEP workshop attendees at the CSULA hydrogen station

About 1,500 visitors have toured the facility in the past year with about 85% of them being students of all ages. To enhance student learning, an educational poster has been developed and installed on a unit in the fueling island and another in the station touring area, Figure 2. Additionally, CSULA has hosted a number of professional meetings, first-responder training, etc. Several students have been interning at the station and some have secured jobs in the hydrogen infrastructure field. The campus has acquired three Hyundai fuel cell vehicles, which are deployed in public safety and commuter roles, Figure 3.



**FIGURE 2.** Hydrogen station operation educational poster in the station touring area



**FIGURE 3.** CSULA hydrogen public safety vehicle

## CONCLUSIONS AND FUTURE DIRECTIONS

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