



2014 DOE Hydrogen Program and Vehicle Technologies Program AMR

CSULA Hydrogen Refueling Facility Performance Evaluation and Optimization

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prepared April, 2014

Project ID
TV024



Overview

Timeline

- Start: 10/01/2012
- End: 09/30/2016

50% complete

Budget

- Expenditure of Government Funds
 - FY13 \$90,000
 - FY14 \$100,000
- Total project funding
 - DOE \$400,000
 - Contractor \$400,000

Partners

- California State University, Los Angeles— [Project lead](#)
- Hydrogenics Corp.

Barriers

Hydrogen Production and Delivery

- Reduce the cost of compression, storage, and dispensing at refueling stations
- Research and develop low-cost, highly efficient hydrogen production technologies

Technology Validation

- Validate complete systems of integrated hydrogen and fuel cell technologies for transportation, infrastructure and electricity generation applications under real-world operating conditions.

Education

- Educate key audiences to facilitate near-term demonstration, commercialization, and long-term market acceptance.



Project Objectives

- The project objective is to test, collect data, and validate hydrogen refueling architecture deployed at CSULA and its individual components in a real-world operating environment. The performance evaluations data will be provided to the Hydrogen Secure Data Center (HSDC) at NREL.
- Academic objectives
 - Contribute to the development of new industry standards
 - Develop and implement fueling station system performance optimization
 - 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



Tasks: Phase 1

Task 1. Develop data acquisition (DAQ) for station performance with existing capability

Task 2. Design and implement enhanced data acquisition (DAQ) for station performance evaluation

Task 3. Enable hydrogen purity testing and reporting

Task 4. Regular data collection and reporting after completing Task 2



Tasks: Phases 2 and 3

Task 4. Regular data collection and reporting after completing Task 2

Task 5. Conduct outreach and training activities for public and government and engage students in station related activities.

Task 6. Data reporting update and station performance optimization after completing Task 4

Task 7. Evaluate station utilization and assess the need for station upgrades and enhanced performance

Hydrogen Fueling and Research Facility



CSULA Hydrogen Station Specs

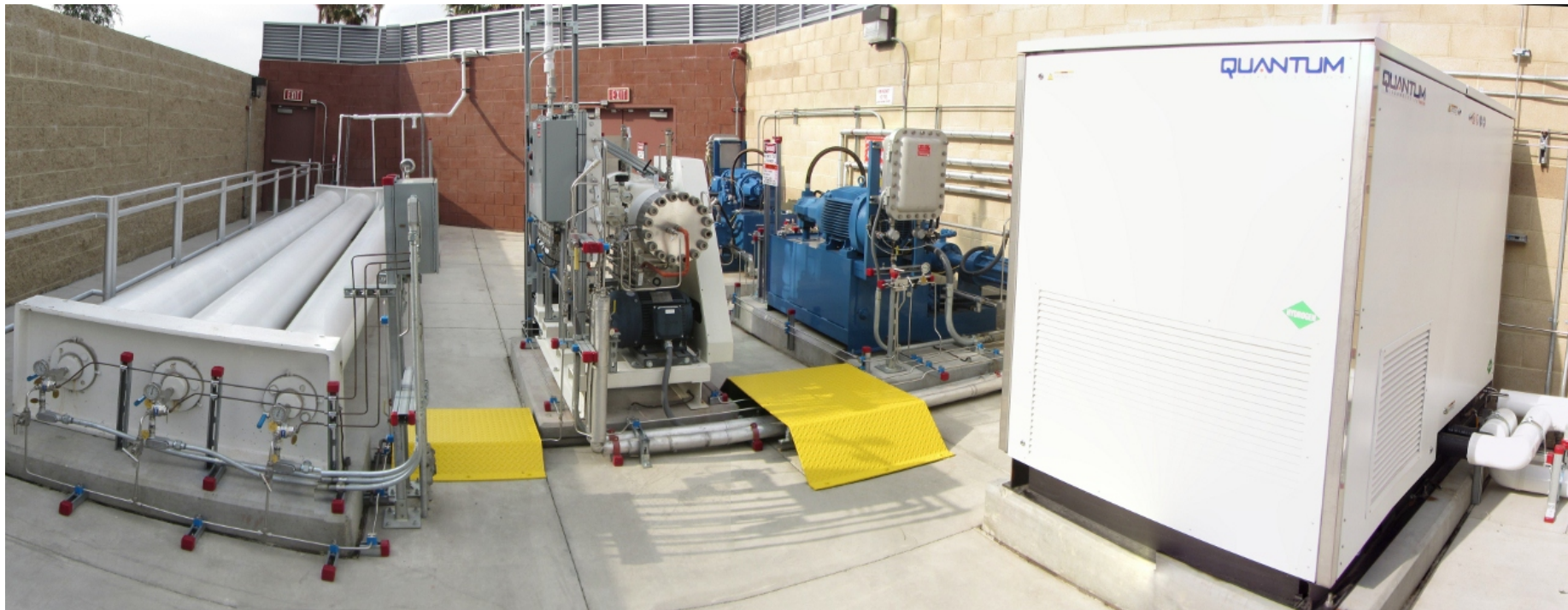


Production: 60 kg/day

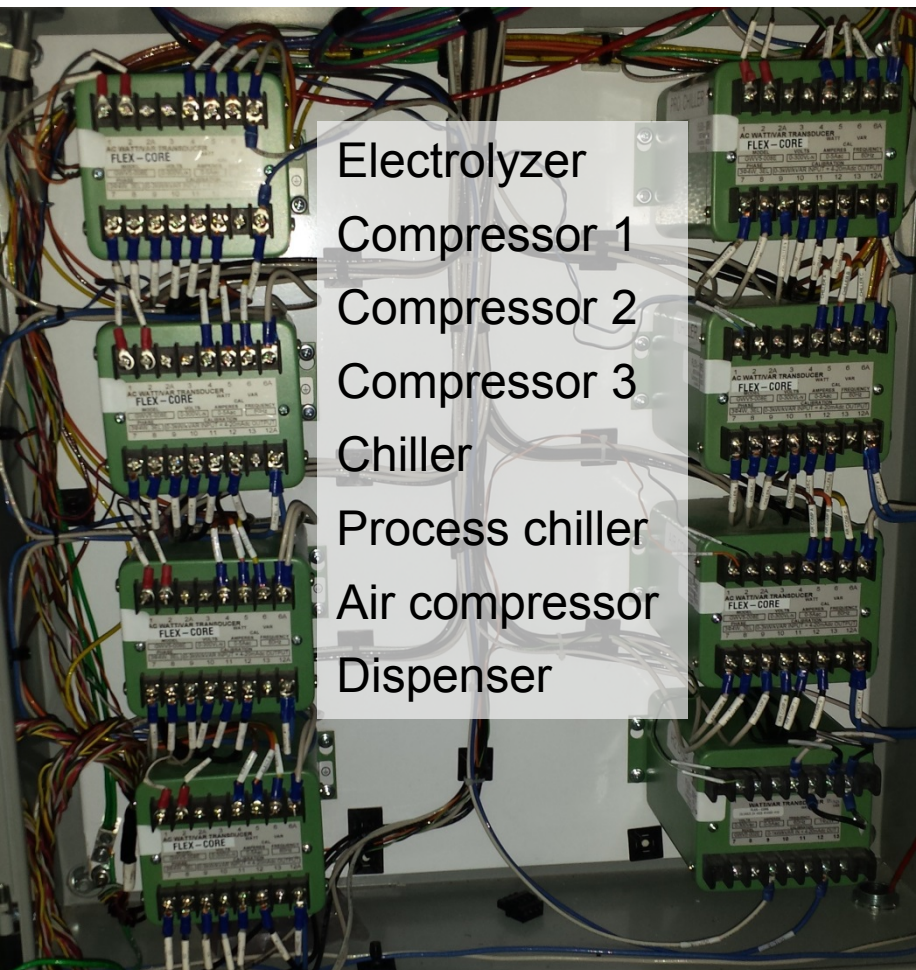
Storage: 60 kg

Pressure: 5,000 and 10,000 psi

Capacity: 15-20 fuel cell vehicles per day



Approach/Strategy: Facility Power Meters



Facility Power Meters Junction Box

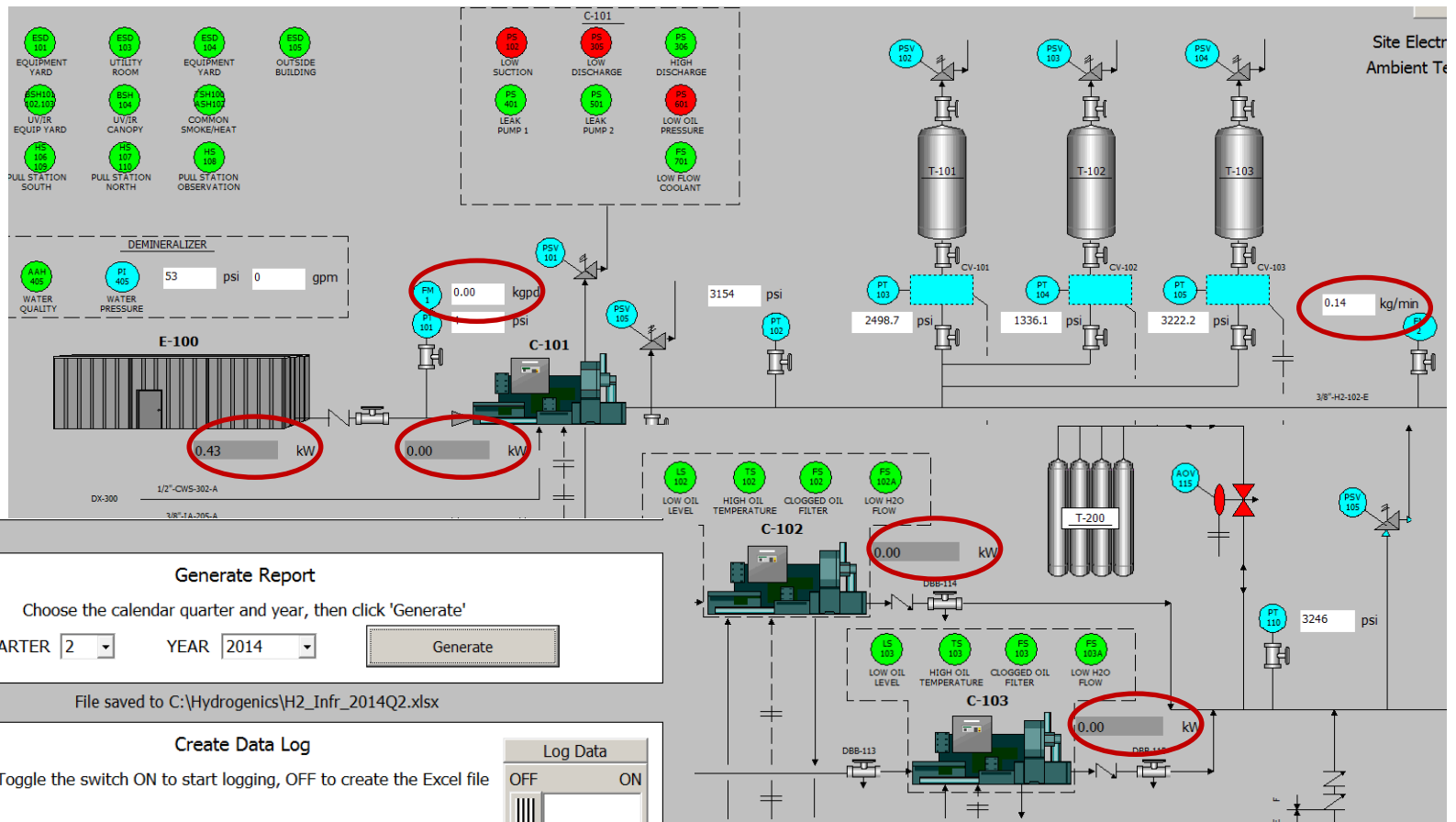


Facility Master
Meter:
Base load
(above)
Electrolyzer on
(right)





Accomplishments: Readings in the Interface





Accomplishments: Reports Automatically Generated

H2_Infr_2014Q2.xlsx [Protected View] - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Add-Ins Acrobat

111

Compression

Template last updated on April 5, 2012 (NREL)

Copy this sheet for multiple compressors

Calendar Quarter (ex. 2011Q2)	2014Q2
Site Name	CSULA
Compressor Type	Diaphragm
Compressor Manufacturer/ Model	PDC-4-1000/7500, 0.044 kg/min
Compressor Efficiency (%) (2)	60%
Output Pressure (example: 350 bar)	450

Data should be from reporting quarter

Monthly Data Table		Month		
Category	Units	Month1	Month2	Month3
Hydrogen Compressed	kg	35	0	0
Operation Time	hours	16	0	0
Electricity Used (ex. monthly bill)	kWhr	44	0	0

Instructions Site Summary Site Log **Compression_1_350** Compression_2_700 Compression_3_700 Dispensing Fi

Ready

100%

Data is collected in Microsoft SQL database
Upon request performance reports are automatically generated

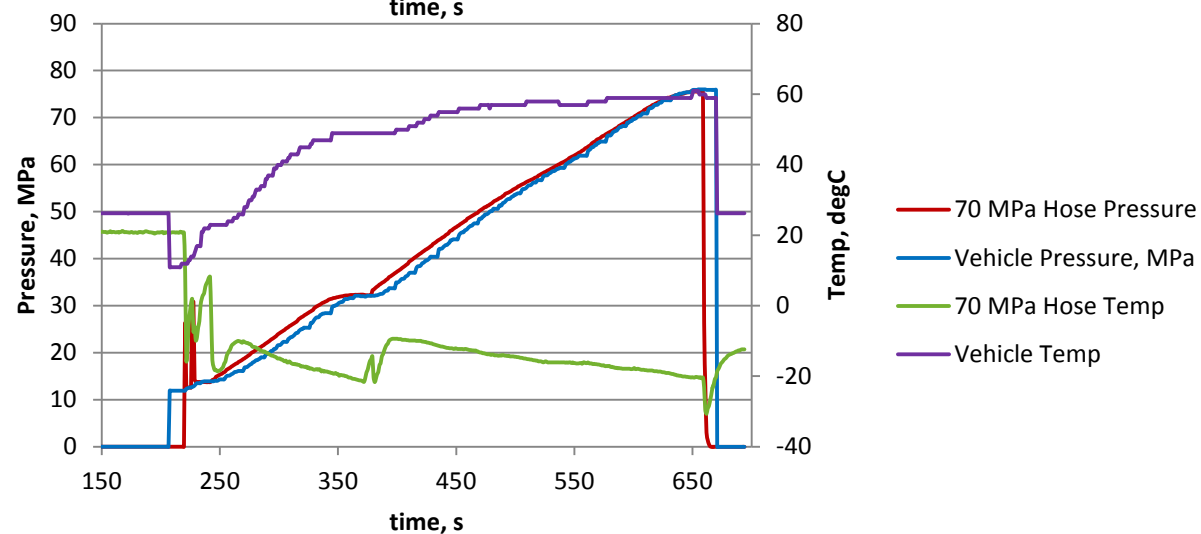
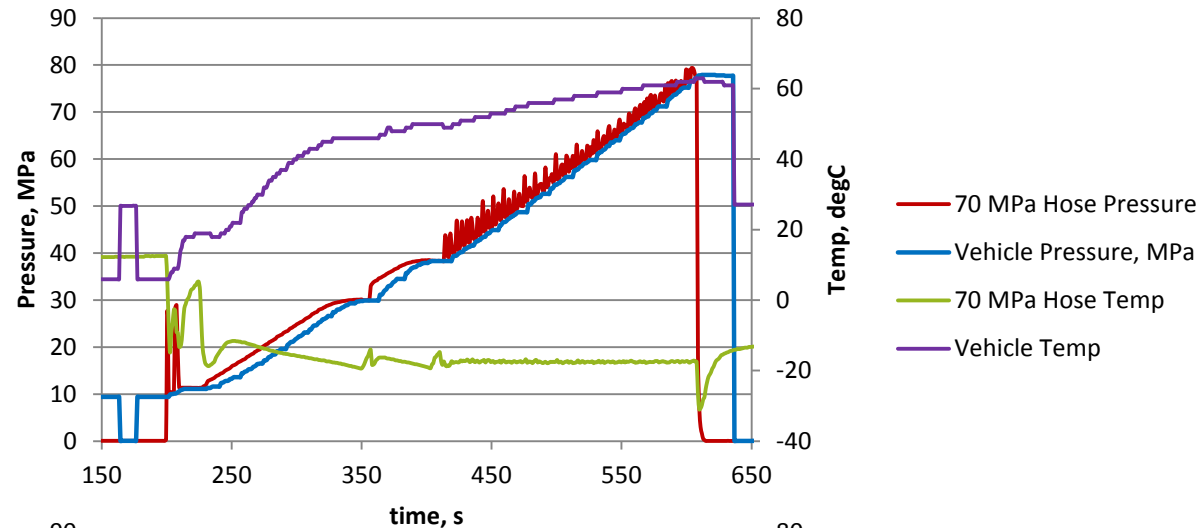
Performance Upgrades

Up to 10 MPa pulsations
are observed during fueling

(top right)

Pulsation-free fueling
(bottom right)

4 x 50L 70MPa buffer tanks
(below)



Hydrogen Purity Testing

- MRI: Acquisition of a Multifunctional Hydrogen Gas Analyzer for the Center for Energy and Sustainability
 - NSF, \$512,000



Collaborations: Dispensing Meter Testing

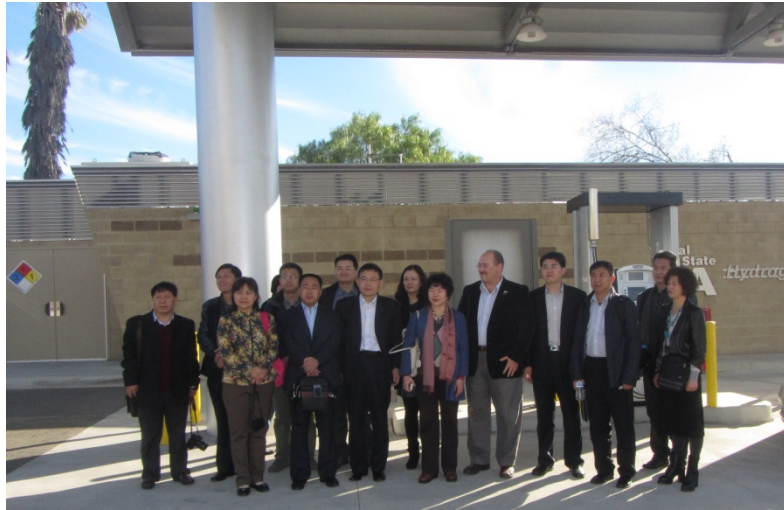
2.505 kg

1.101 kg

1.405 kg



Outreach

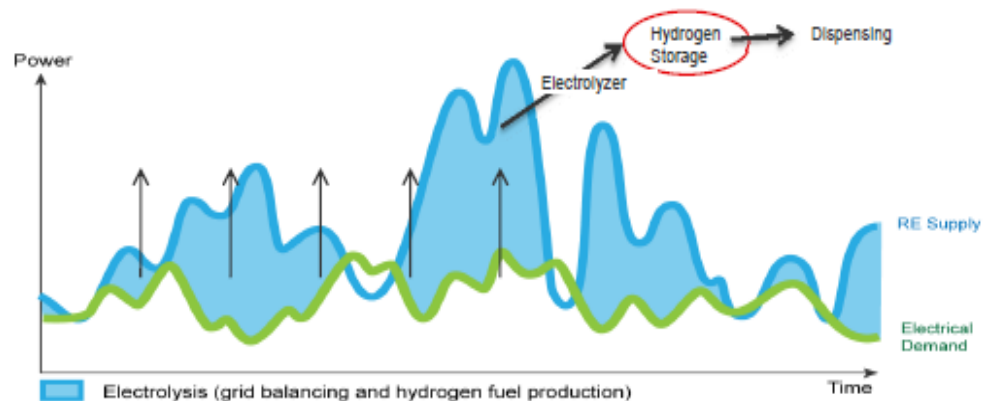


International
visitors
First responder
training
Scholars,
students
Professional
meetings
Local
government



Future Work: Research Opportunities

- Performance Optimization, Hydrogen Fleet and Infrastructure Analysis
 - Weekly patterns/storage
 - Availability via mobile app
 - Metering
- Smart Grid: Load Following with Renewable Power Generation
 - Off-peak load
 - Load shedding
- Workforce, Public and Professional Education



Intermittent wind exceeds load



Summary

- **RELEVANCE.** Program demonstrates high relevance to the DOE Hydrogen and Fuel Cell program especially in light of rapid development of hydrogen infrastructure in CA and thousands of FCV expected in 2015.
- **APPROACH.** Reviewed NREL reporting requirements and identified instrumentation needed. Developed pathways to improve station performance.
- **ACCOMPLISHMENTS.** Tasks 1 and 2 completed. Transitioning into 3, 4 and 5. Implemented installation of power and flow meters. Installed buffer tanks. Created Microsoft SQL database, ability to generate quarterly reports and perform individual equipment performance assessment.
- **COLLABORATIONS and OUTREACH.** Rapid development of collaborations: CA DMS, CAFCP, H2FIRST. Funded member of the Southern CA Alternative Fuel Center. Conducted robust outreach activities.
- **FUTURE WORK.** Short term: collecting data, analyzing station and individual equipment performance. Long term: smart grid, infrastructure and expanded education opportunities.