California Hydrogen Infrastructure Project

Edward C. Heydorn (Principal Investigator)
Carolyn Caporuscio (Presenter)
Air Products and Chemicals, Inc.
13 May 2011

Project ID
#TV007

This presentation does not contain any proprietary, confidential, or otherwise restricted information
Overview

Timeline
- Start – Aug. 2005
- End – Dec. 2011
- 91% Complete

Budget
- Total project funding
  - DOE $5.5 million share
  - Contractor $5.4 million share
- Funding received in FY10: $0
- Funding for FY11: $0

Barriers
- Cost of delivered hydrogen

Partners
Various collaborators and funding groups including:
- South Coast AQMD
- OEM’s
- UC Irvine
- Energy Companies
- FuelCell Energy, Inc.
Objectives - Relevance

• Demonstrate a cost effective infrastructure model in California for possible nationwide implementation
  – Design, construct and operate five hydrogen fueling stations
  – Collect and Report Infrastructure Data
  – Document permitting requirements and experiences
  – Validate expected performance, cost, reliability, maintenance, and environmental impacts

• Implement a variety of new technologies with the objective of lowering costs of delivered hydrogen
Approach

• Work with OEM’s to determine vehicle usage needs and general station equipment requirements
• Work with OEM’s and others to determine preferred locations/areas for fueling station deployment
• Select potential Station Operators and work to locate suitable sites
• Initiate and complete required agreements, determine and address specific site issues including liability, billing, etc.
• Complete detailed Station Design, permits, installation, operation, and maintenance of stations
• Collect and report Infrastructure Data to the DOE once stations put online
• Monitor and collect feedback which can be incorporated to improve station user’s fueling experience
Project Tasks

- Station Installation
  - UCI Fueling Station
  - Torrance Pipeline Fueling Station
  - Northern California Mobile Fueler (HF-150)
  - Fountain Valley Renewable Station
  - Long Beach Mobile Fueler (HF-150)
- New Delivery Concept (NDC)
- Infrastructure Data Acquisition, Analysis and Delivery (includes eRAM)
- Hydrogen Infrastructure Study (UC Irvine)
University of California, Irvine

UCI 350/700 Bar Station

- 25 kg/day capacity, liquid hydrogen supply
- Actual demand higher, regularly approaching 50 kg/day
- 350 and 700 bar fueling capability
- Excellent operating performance
- Proposal by Air Products to expand station to 100 kilograms per day selected by California Energy Commission

The UC Irvine Fueling Station operated by the National Fuel Cell Research Center (NFCRC) photo by Lorin Humphries.
Torrance Pipeline

Torrance Pipeline Station

- 48 kg/day capacity, pipeline hydrogen supply
- 350 and 700 bar fueling capability
- Greenfield station, retail-like design
- Station construction began February 2010
- Vehicle test fills completed March 2011
- Expandable with additional compression to 96 kg/day
- In fully deployed hydrogen economy, pipeline-supplied stations can dispense hydrogen at $4.50-5.00 per kg
- Funding support by Shell Hydrogen and South Coast Air Quality Management District
Recent Advances in Fueling Station Capabilities

- Station supplied from active industrial pipeline
- Meets SAE TIR-J2601
- Use of 15,000 psig ground storage, enabling 70 MPa cascade fueling
- Capable of 4 simultaneous vehicle fuelings (2 @ 35 MPa, 2 @ 70 MPa)
- Dual PLC dispenser (+ supervisory PLC)
- Vehicle identification system for OEM-specific fueling protocols (HVAS)
Northern California HF-150

Placerville Station

- Gaseous hydrogen supply
- 350 bar fueling capability
- Host site: U.S. Forest Service, Eldorado National Forest
- Installed March 2010
- Planned 6 month deployment extended to December 2010
- Funding support by Nissan
Fountain Valley Renewable Hydrogen

Fountain Valley Station

- 100 kg/day capacity
- 350 and 700 bar fueling capability
- SAE TIR-J2601 compliant
- Host site: Orange County Sanitation District
- Co-located with existing CNG dispenser
- Renewable hydrogen production using Hydrogen Energy Station
- Scope includes design/procurement of ADG fuel treatment system
Hydrogen Energy Station

- Technology developed under second DOE Cooperative Agreement (No. DE-FC36-01GO11087)
- Overall project (including 3 years of operation) selected for funding by California Air Resources Board and South Coast Air Quality Management District
Orange County Sanitation District Site

Hydrogen Fueling Station

~1,100 feet

Ellis Avenue

Hydrogen Energy Station
Commissioning of Hydrogen Fueling Station

- November 2010: Mechanical completion of hydrogen fueling station
- 25 February 2011: First hydrogen from Hydrogen Energy Station to hydrogen fueling station
- 08-10 March 2011: Initial test fills of fuel cell vehicles
Ongoing Activities at Fountain Valley Renewable Station

- March 2011: Obtain occupancy permit for hydrogen fueling station
- April 2011: Delivery and installation of clean-up system for anaerobic digester gas
- Spring 2012: Complete 1 year of refueling data reporting under DOE Cooperative Agreement
- Operation to continue for a total of 3 years under CARB/SCAQMD sponsorship
Collaboration

- University of California, Irvine
  - Host site and operator, UCI Fueling Station
  - Operations support and data analysis, Fountain Valley Renewable Station
Future Work

• UCI Fueling Station – Continue operation
• Torrance Pipeline Fueling Station – Continue operation
• Fountain Valley Renewable Station – Continue operation
• Infrastructure Data Acquisition, Analysis and Delivery – Continue to report data to DOE
• Extend DOE Cooperative Agreement to allow for 1 year of fueling data from Torrance and Fountain Valley stations
Summary

• Demonstrate a variety of options for delivery of low-cost hydrogen in the deployment of hydrogen Infrastructure
  – First permanent CHIP station (350 and 700 bar gaseous hydrogen) in operation at UCI
  – Two mobile CHIP stations (HF-150) (Long Beach, Placerville)
  – New Delivery Concept (NDC) trailer deployed
  – Infrastructure Data Reporting at each station
  – First pipeline supplied hydrogen station in operation in Torrance
  – Renewable-supplied hydrogen station in operation in Fountain Valley
Thank you
tell me more
www.airproducts.com
Acknowledgement & Disclaimers

This material is based upon work supported by the Department of Energy (Energy Efficiency and Renewable Energy) under Award Number DE-FC36-05GO85026. This presentation was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This presentation was prepared as a result of work sponsored, paid for, in whole or in part, by the South Coast Air Quality Management District (AQMD). The opinions, findings, conclusions, and recommendations are those of the author and do not necessarily represent the views of AQMD. AQMD, its officers, employees, contractors, and subcontractors make no warranty, expressed or implied, and assume no legal liability for the information. AQMD has not approved or disapproved this presentation, nor has AQMD passed upon the accuracy or adequacy of the information contained herein.