2008 DOE Hydrogen Program
Hydrogen Codes & Standards

Robert Burgess
Carl Rivkin, Chad Blake, Russ Hewett, Ed Tracy,
Jim Ohi, Dennis Barley, Keith Gawlik, Bill Buttner

National Renewable Energy Laboratory

June 12, 2008

Project ID #
SCS1

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

Overview

Timeline

- Start date: Oct 1, 2007
- End date: Sep 30, 2008
- Percent complete: 50%
  (C&S work on-going since 1997, defined and funded annually)

Budget

- Funding received in FY07: $4.0M
- Funding for FY08: $4.2M

Barriers

- Consensus - Achieving national agenda on codes & standards (A,B,D,L,J)
- Representation – Government & Industry support and DOE limited role (F,G,H,I,K)
- Technology Readiness – Jurisdictional issues related to available codes and existing set back distances (M,N,P)

Partners

- National H2/Fuel Cells Codes and Standards Coordinating Committee (NHA, USFCC)
- FreedomCAR-Fuel Partnership C&S Technical Team
- NASA, ISO, ICHS, IIT, JRC

Objectives

- Conduct research & development (R&D) needed to establish sound technical requirements for hydrogen codes & standards.
- Support code development for the safe use of hydrogen in commercial, residential, and transportation applications.
- Advance hydrogen safety, code development, and market transformation issues by collaboration with appropriate stakeholders.
- Facilitate the safe deployment of hydrogen technologies

Approach

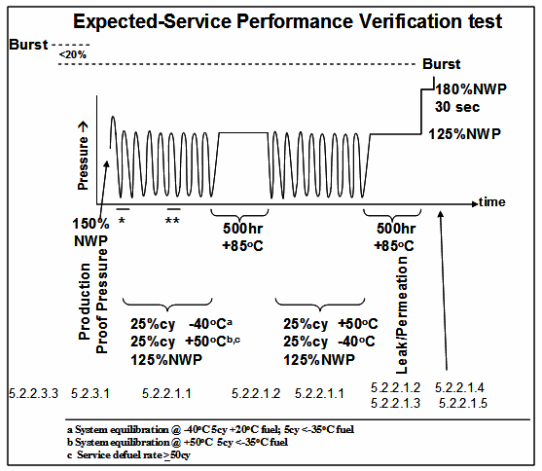
- Research and Development
  - Onboard hydrogen storage system testing, 70 MPa fueling component testing, fuel quality testing, safety sensor testing, HPRD testing, modeling/simulation of hydrogen leak in residential garage,
- Codes & Standards Coordination
  - Code Development Support: SAE, NFPA, CSA, ICC, ISO, IEC
  - Coordination Committees: C&S Tech Team, HIPOC, NHFC4
- Collaboration
  - SNL, LANL, ORNL, ANL, PNNL, NASA, NIST, IIT, JRC, UL, NHA, USFCC, SDO's, CDO's, Industry
- Support Technology Readiness
  - Permitting workshops, web based information compendium, hydrogen fact sheets

Technical Accomplishments
Highlights presented in following slides

- Onboard Storage System Testing (SAE J2579)
- 70 MPa Component Testing
- Fuel Quality Specification
- Safety Sensor Testing
- Modeling/Simulation of Leak Scenarios in Residential Garages
- Codes & Standards Development
- Permitting Workshops
- Web-based Information Compendium

70 MPa Onboard Storage Testing

SAE J2579 performance based test sequence



Post test burst strength determination

- Objective: Validate performance based testing of onboard fuel systems as prescribed in SAE J2579
- Status:
  - Completed determination of time required for prescribed cyclic testing
  - Completed glass wrapped tank verification testing
  - Completed hydraulic testing of type 3 and type 4 systems
  - Working on gas cycle testing

J2579 was balloted and approved, December 07 as TIR (Technical Information Report), establishing performance based duty cycle testing

70 MPa Component Testing

Testing of breakaways, fittings nozzles, & hoses

- Objective: Conduct performance based testing of fuel system components.
- Status:
  - Defined test sequence.
  - Tests will be conducted over the next eight months.

70 MPa testing will generate important data for performance based code language verification

Fuel Quality R&D and Testing

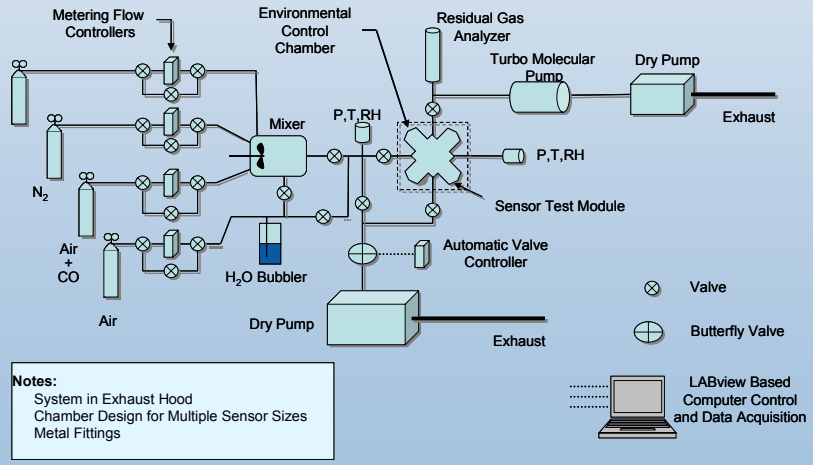
- ISO Technical Specification (TS14687-2) published February 2008
  - guidelines for PEMFC road vehicles during initial demonstration phase
  - harmonized with SAE J2719 (Technical Information Report)
  - standardized analytical methodologies must be developed and validated
- International standard (ISO 14687-2) by late 2010 (target date)
  - standard requires sufficient data and adequate level of confidence in data to set allowable limits for non-hydrogen constituents
    - focus on “critical contaminants” that are technology and economic drivers
      - CO, He, S, NH_3, PM, CH_4, and other inerts
  - include technical annex explaining rationale and data/modeling used to derive limits
- Coordinated testing and modeling underway at national labs, universities in US, Asia, EC
  - North American team of experts represents U.S. and Canada at ISO
  - similar team effort underway at SAE
  - standardized sampling and analytical methodologies under development by ASTM
    - 70 MPa sampling apparatus developed and under testing

Safety Sensor Testing

Automated Test Apparatus Design

- Objective: Perform validation testing of new and existing sensor technologies
  - Project is designed to provide accurate and reliable product information to facilitate the safe use of sensors in industrial and residential applications
  - Provide DOE data for substantiation of 2012 hydrogen safety sensor performance targets

- Status:
  - Collaboration with others in universities, government and industry
  - Compiled test protocol based on existing standards and best practices
  - Test apparatus design and component procurement in process

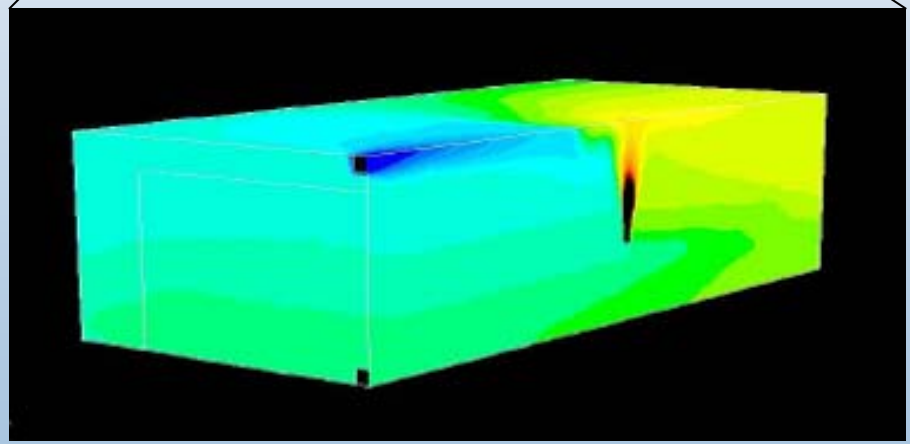


Modeling/Testing in Residential Garages

Testing being completed to validate CFD modeling

- Objective:
  - Provide data for hydrogen release in confined space
  - Work will lead to understanding of hydrogen safety sensor placement

- Status:
  - CFD modeling completed based on actual garage geometry
  - Initial guidelines for vent size requirements
  - Model validation being conducted employing helium as surrogate test fluid



Reference: Analysis of Buoyancy-Driven Hydrogen from Buildings, Barley et al

Codes & Standards Development

- Manage codes and standards development
  - Supporting CSTT (Codes & Standards Tech Team)
  - Co-chair of National Hydrogen and Fuel Cells Codes & Standards Coordinating Committee (NHA, USFCC)
  - Work on HIPOC (Hydrogen Industry Panel on Codes)
  - Technical support of Regulatory Logic contracts
- Direct Participation on Codes & Standards Committees
  - SAE J2579 – Onboard Hydrogen Storage – released Dec 07 as TIR
  - SAE J2578 – General Fuel Cell Vehicle Safety – final editing prior to release for ballot
  - NFPA 2 – Hydrogen Technologies Code – Working on 2010 release cycle
  - ISO TS14687-2 – Hydrogen Fuel Quality – coordinate North American team of experts

Workshops on Permitting H2 Fueling Stations and H2 Fuel Cells for Back-up Power

- Workshops held in Atlanta (Jul 07) & Santa Ynez, CA (Mar 08)
  - held in key locations identified by industry with invited code officials and hydrogen facility developers
  - provide essential background on hydrogen technologies and applications
    - hydrogen fueling stations
    - hydrogen fuel cells in telecom applications
    - address experience in permitting projects
  - provide workshop participants with opportunity to conduct “virtual permitting” of projects
    - how to permit, given available information about projects and existing codes and standards
    - identify critical issues to make permitting process more timely and cost effective
    - identify any codes and standards gaps
- Proceedings on NHA website: www.hydrogenandfuelcellsafety.info
- Workshops planned for May 08 in NYC-NJ, 2 others in key states and regions

Web Based Information Compendium *Accessible at*

http://www.hydrogen.energy.gov/fueling_stations/

U.S. DEPARTMENT OF ENERGY
Hydrogen Program

hydrogen.energy.gov

SEARCH FUELING

Search Help

Hydrogen Fueling Station Codes and Standards

- Hydrogen Fueling Stations
- Permitting Process
- Codes & Standards Search
- Related Links
- Contacts

As the nation moves toward a hydrogen economy, key infrastructures must be developed to support the growing number of hydrogen-powered vehicles. One basic need is hydrogen fueling stations. These stations will provide the hydrogen to power America's vehicles, and economy, toward energy independence.

Today, more than 60 hydrogen fueling stations are operating throughout the United States. However, fewer than 20 are available for public use. In contrast, according to the U.S. Census Bureau, the United States has more than 121,000 gasoline fueling stations. If hydrogen-powered vehicles are to become an important, and common, technology of America's energy future, a vast network of public stations will be necessary to support them.

Although there is only a small number of hydrogen fueling stations today, national codes and standards have been developed to address their construction, operation, and maintenance. These codes and standards are necessary to ensure safe development and deployment, and many organizations are working to improve the existing codes and standards and address remaining gaps.

To support smoother, more efficient permitting of hydrogen fueling stations, the U.S. Department of Energy is working with codes and standards development organizations, code officials, national laboratories, and industry experts. Its goals are to identify and address hydrogen fueling station codes and standards issues, support the creation of relevant codes and standards, and provide up-to-date information to permitting officials.

Learn more about:

- Hydrogen fueling stations
- The hydrogen fueling station permitting process
- Hydrogen fueling station codes and standards.

Although only a few hydrogen fueling stations are operating today, they will become more common in the future

Search for Hydrogen Fueling Station Codes and Standards.

Contact Us | Security & Privacy | Hydrogen Program Home | USA.gov

Future Work

- Component Testing
  - Complete existing efforts on performance based testing supporting SAE code development
  - Continue work on HPRD code development by defining and implementing test validation
- Hydrogen safety sensor testing effort will continue with baseline testing of sensor technologies and will work toward standardization of test methods
- Evaluate NDE (Non Destructive Evaluation) methods for hydrogen storage applications including fiber optic strain gauge
- CFD model validation for low level indoor hydrogen leaks, work will lead to design guidelines, recommendations for codes & standards and future work on residential fueling stations & commercial service buildings
- Continue work with national and international codes & standards development through direct support of SDO and CDO organizations and collaboration with key stakeholders
- Extend web based compendium to include hydrogen fuel cell back up power for wireless telecommunications facilities

Summary

- Research and development efforts will be focused on enabling technologies through ongoing programs such as component testing, hydrogen fuel quality testing, and hydrogen safety sensor testing
- Codes & standards development will continue through direct support of standards development organizations and participation on coordination committees
- These goals can only be accomplished through collaborations with key stakeholders at all levels
- NREL will continue to support technology readiness of hydrogen technologies through programs such as the workshops for permitting officials and the web-based information compendium