



NREL National Renewable Energy Laboratory
Innovation for Our Energy Future

2009 DOE Hydrogen Program Codes & Standards



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Energy Laboratory*

Hydrogen Technologies
& Systems Center

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Project ID #
scs_01_rivkin

Overview

T I M E L I N E

- *Start date: Oct 1, 2008*
- *End date: September 30, 2009*
- *Percent complete: 60%*

(C&S work on-going since 1997, defined and funded annually)

B U D G E T

- Funding in FY08:
- **\$3.75M**
- Funding for FY09:
- **\$4.75M**

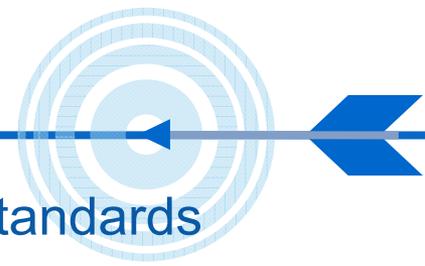
B A R R I E R S

- **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*)

P A R T N E R S

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

Relevance— Objectives



- Implement the DOE's National Template of Codes and Standards
- Conduct research & development (R&D) needed to establish sound technical requirements for renewable energy codes & standards with a major emphasis on hydrogen.
- Support code development for the safe use of renewable energy in commercial, residential, and transportation applications with a major emphasis on vehicles.
- Advance renewable energy safety, code development, and market transformation issues by collaboration with appropriate stakeholders.
- Facilitate the safe deployment of renewable energy 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 America, ICC, CGA, ISO, IEC

Coordination Committees: C&S Tech Team, HIPOC, NHFC4

Collaboration

SNL, LANL, ORNL, ANL, PNNL, NASA, NIST, JRC, UL, NHA, USFCC, CaFCP, CARB, SDO's, CDO's, Industry Support Technology Readiness/Market Transformation Permitting workshops, web based information compendium, hydrogen fact sheets, third party safety reviews

Technical Accomplishments and Progress



Codes &
Standards
Development

70 MPa
Component
Testing

Fuel Quality
Specification

Safety
Sensor
Testing

Modeling/Simulation
of Leak Scenarios in
Residential Garages

Third party
safety
reviews

Permitting
Workshops

Web based
Information
Compendium

Technical Accomplishments and Progress



70 MPa Onboard Storage Testing

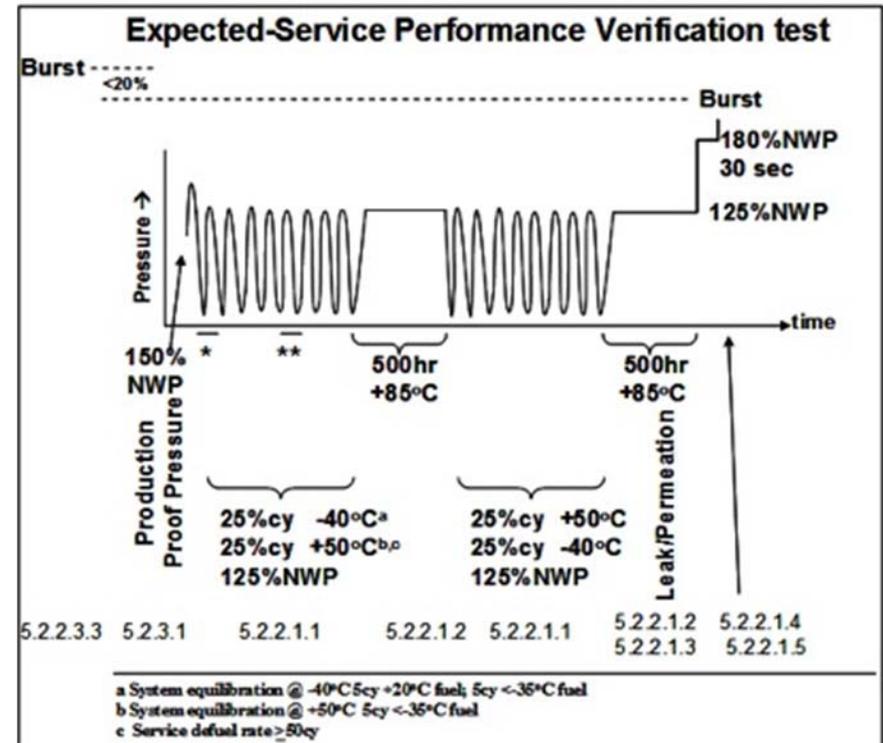
Objective:

- 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
- Completed gas cycle testing

SAE J2579 performance based test sequence



J2579 was balloted and approved, January 2009 as TIR (Technical Information Report), establishing performance based duty cycle testing



ISO Technical Specification (TS14687-2) published February 2008

International standard (ISO 14687-2)

- Committee Draft (CD) Adopted in February 2009
- Draft International Standard (DIS) by October 2009
- International Standard (IS) by April 2011

Coordinated effort & schedule in place for SAE J2719 (TIR)

Coordinated testing and modeling underway at national labs, universities in US, Asia, EC

- Coordination of fuel cell testing activities
- Development of standardized sampling and analytical methodologies through ASTM and other partners
- Production systems testing and evaluation
- Particulate matter sampling and characterization

Information is reported and shared on NREL Extranet Page for participants

Technical Accomplishments and Progress



Safety Sensor Testing, Automated Test Apparatus Design

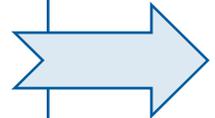
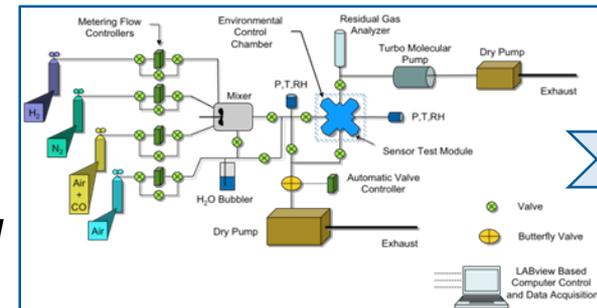
Objective:

- 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
- Additional test capability coming on line later in FY2009
- Market definition activities include over 120 sensor technologies

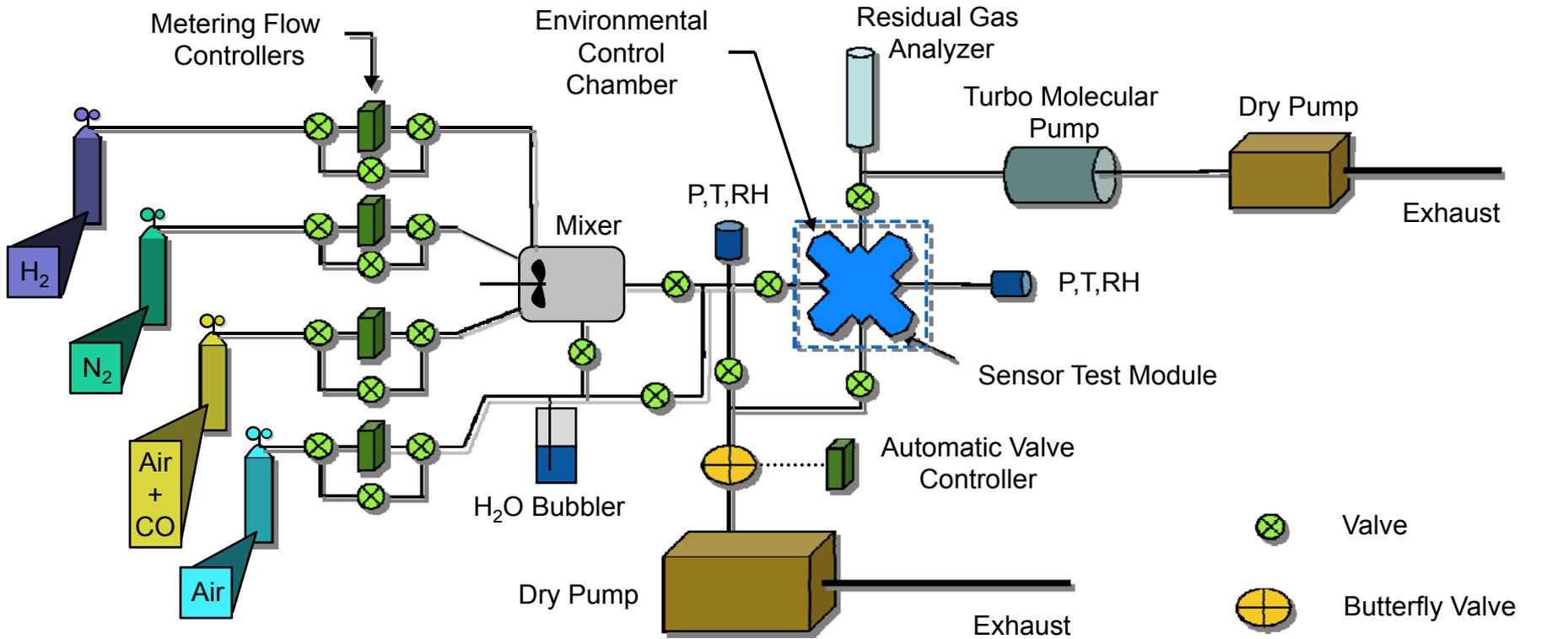
[See diagram on next slide]



Technical Accomplishments and Progress



Safety Sensor Testing, Automated Test Apparatus Design



Notes:
System in Exhaust Hood
Chamber Design for Multiple Sensor Sizes
Metal Fittings

.....
 LABview Based
Computer Control
and Data Acquisition



Modeling/Testing in Residential Garages

Objective:

- Understand indoor slow release behavior
- Effective placement of hydrogen safety sensors

Status:

- CFD modeling completed based on actual garage geometry
- Model validated using helium as surrogate test fluid

Testing completed to validate CFD modeling



Reference: Buoyancy-Driven Ventilation of Hydrogen from Buildings: Lab test and Model Validation, 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
- Directing National Template Implementation

Direct Participation on Codes & Standards Committees

- **SAE J2579:** Onboard Hydrogen Storage
- **SAE J2578:** General Fuel Cell Vehicle Safety
- **NFPA 2 – Hydrogen Technologies Code** – Working on 2010 release cycle
- **ISO TS14687-2: Hydrogen Fuel Quality** – coordinate North American team of experts
- **ISO 20100: Hydrogen fuelling stations**
- **CSA America H4** series of standards
- ISO 26142 Hydrogen Sensors



U.S. DEPARTMENT OF ENERGY
Hydrogen Program
http://www.nrel.gov/

hydrogen.
energy.gov

SEARCH PERMITTING

[Search Help](#)

Permitting Hydrogen Facilities

- > Permitting Process
- > Codes & Standards Search
- > Hydrogen Fueling Stations
- > Telecommunication Fuel Cell Use
- > Hazard & Risk Analysis

The objective of this U.S. Department of Energy Hydrogen Permitting Web site is to help local permitting officials deal with proposed hydrogen fueling stations, fuel cell installations for telecommunications backup power, and other hydrogen projects.

A [permitting process](#) section seeks to help project developers and the public understand the general procedures involved.

Technology overviews of [hydrogen fueling stations](#) and [telecommunications fuel cell use](#) and [searchable model code information](#) should provide helpful information for local permitting officials to address project proposals.

Hydrogen Fueling Stations



Telecommunication Fuel Cell Use



If you have any suggestions for making this site more useful, please [let us know](#).

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<http://www.hydrogen.energy.gov/permitting/>



Permitting H2 Fueling Stations/H2 Fuel Cells for Back-up Power

- W
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- Workshops held in Teaneck, NJ (May 08), Los Angeles, CA, (Aug 08), Detroit, MI (Sep 08) & Golden, CO (Feb 09)
 - Held in key locations identified by Industry and Regional trade Organizations with invited code officials and project developers
 - Provide essential background on renewable energy technologies and applications
 - Hydrogen fueling stations
 - Hydrogen fuel cells in telecom applications
 - Address experience in permitting projects
 - Provide workshop participants with with basic safety information and an overview of applicable codes and standards
 - Participants develop a permitting tool to assist in future permit review
 - Proceedings on NHA website: www.hydrogenandfuelcellsafety.info
 - 12 Workshops planned for FY09 in key regions

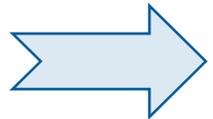


Proposed Future Work

- Component Testing
 - Continue work on high pressure component test work to support code development
 - Hydrogen safety sensor testing effort will continue with baseline testing of sensor technologies and will work toward standardization of test methods
- 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
- Support standard development with special emphasis on electric vehicle standards

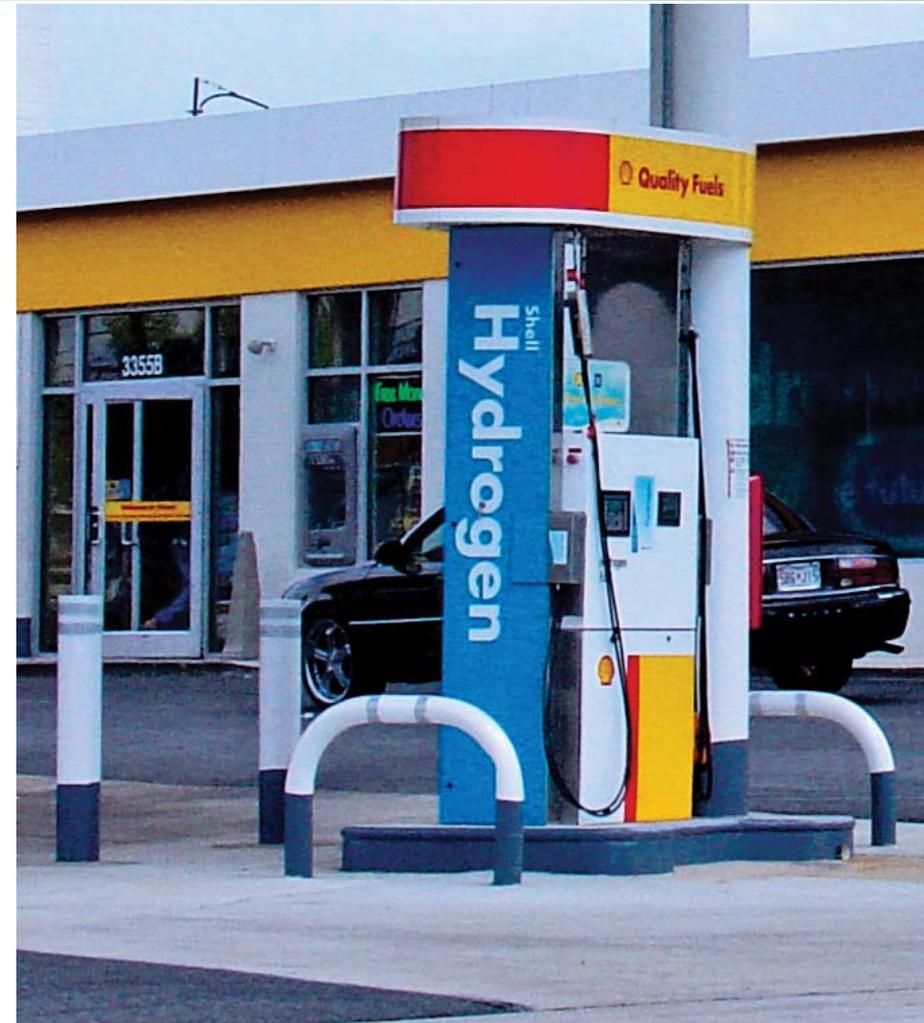


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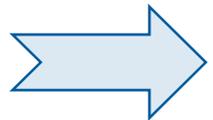


Proposed Future Work

- Fuel Quality Impacts Related to Storage Systems
- Fuel Quality Impacts Related to Various Production Pathways
- Field Instrumentation Research & Development
- Particulate Matter Filter Specifications
- Complete ISO & SAE Adopted Standards Processes
- Continue to implement R&D into revision processes



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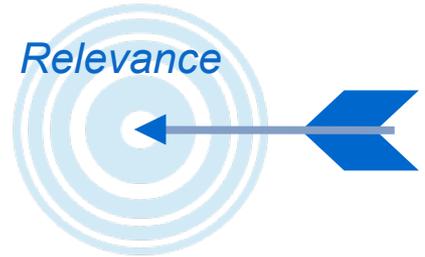
Proposed Future Work

- 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 information on other renewable energy technologies with special emphasis on vehicle technologies
- Continue outreach activities such as workshops and safety reviews



Summary

Research and development efforts will be focused on component testing, hydrogen fuel quality testing, and hydrogen safety sensor testing



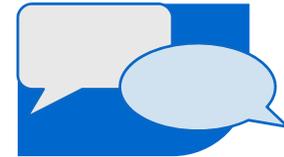
Approach



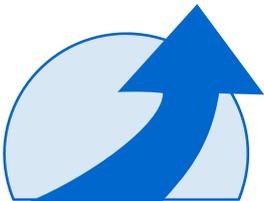
Codes & standards development will continue through direct support of standards development organizations and participation on or operation of coordination committees

These goals can only be accomplished through collaborations with key stakeholders at all levels

Collaborations



Progress



NREL will continue to support technology readiness of renewable energy technologies through programs such as the workshops for permitting officials, safety reviews, and the web based information compendium