



U.S. DEPARTMENT OF  
**ENERGY**

# **Safety, Codes and Standards**

*Antonio Ruiz*

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**2009 DOE Hydrogen Program & Vehicle  
Technologies Program Annual**

**Merit Review and Peer Evaluation Meeting**

*May 22, 2009*



## **SAFETY:**

Develop and implement practices and procedures to ensure safety in the operation, handling, and use of hydrogen and hydrogen systems for all DOE-funded projects and utilize those practices and lessons learned to promote the safe use of hydrogen.

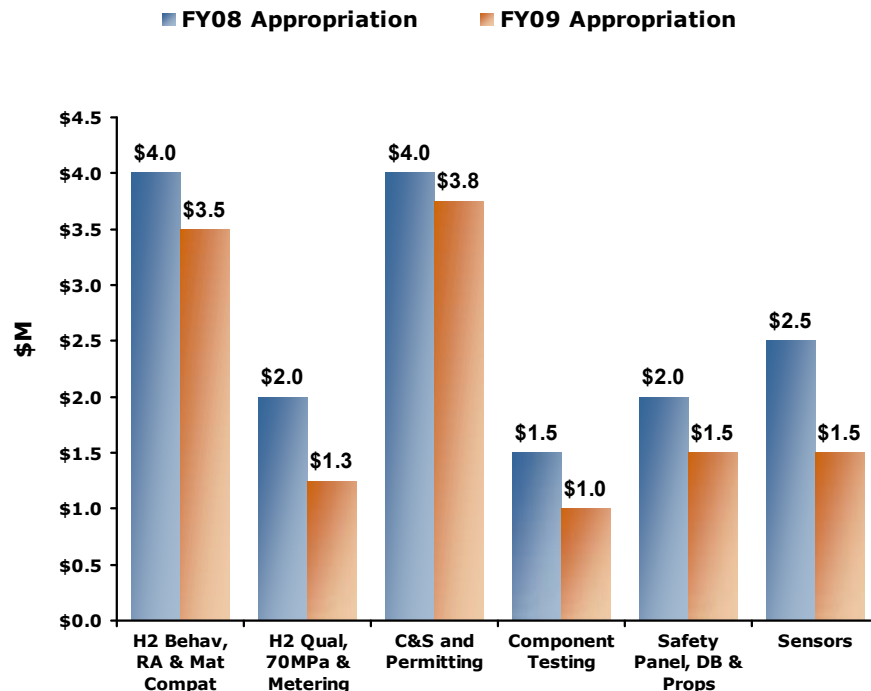
## **CODES & STANDARDS:**

Perform the underlying research to enable codes and standards to be developed for the safe use of hydrogen in all applications. Facilitate the timely development and harmonization of domestic and international codes and standards.



**FY 2009 Appropriation = \$12.5M**

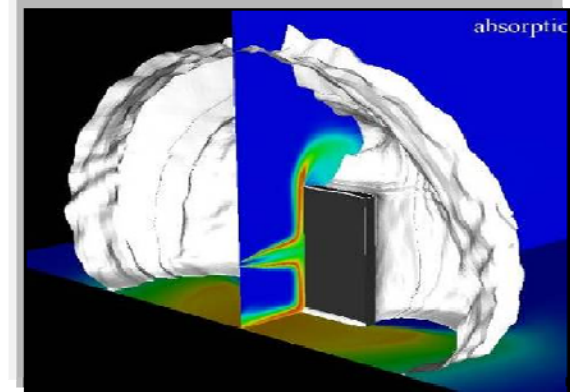
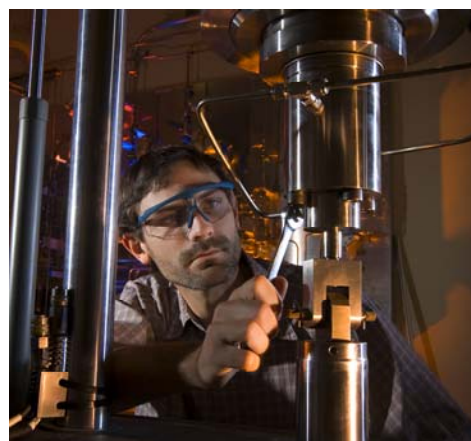
**FY 2008 Appropriation = \$16.0M**



## EMPHASIS

- Technically validated performance data needed for codes and standards.
- Tools to facilitate permitting of hydrogen fueling stations and stationary fuel cell installations.
- Hydrogen fuel quality testing, measurement, and metering.
- Risk assessment and establishment of protocols to identify and mitigate risk.
- Global harmonization of hydrogen fuel quality and other key standards.
- Dissemination of hydrogen best practices and safety information.

- Synchronizing codes & standards development and adoption with technology commercialization needs
- Aligning data generation with codes & standards development cycle
- Facilitating timely adoption of approved codes & standards
- Streamlining and standardizing the permitting process for hydrogen facilities
- Promoting domestic and international consistency
- Compiling and disseminating safety information





## *Introduced Risk-Informed Approach for Separation Distances into NFPA 55 (Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders) 2009 code cycle – June 2009*

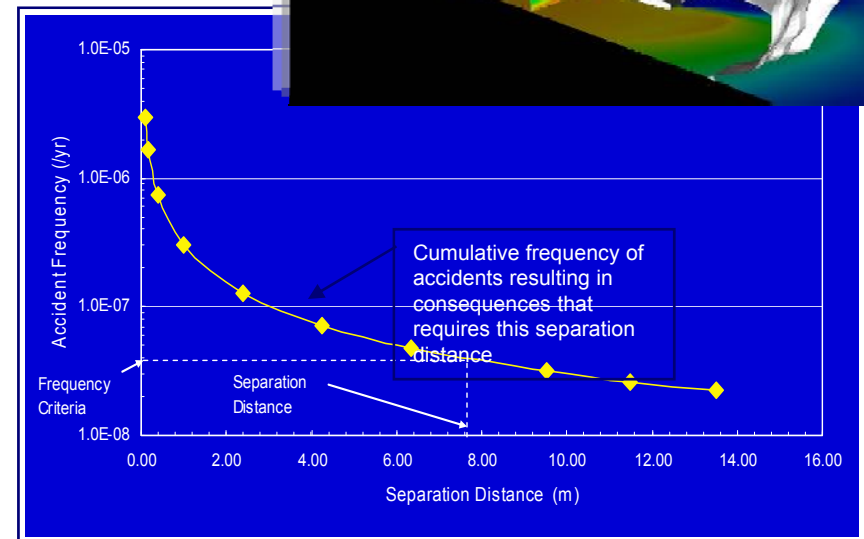
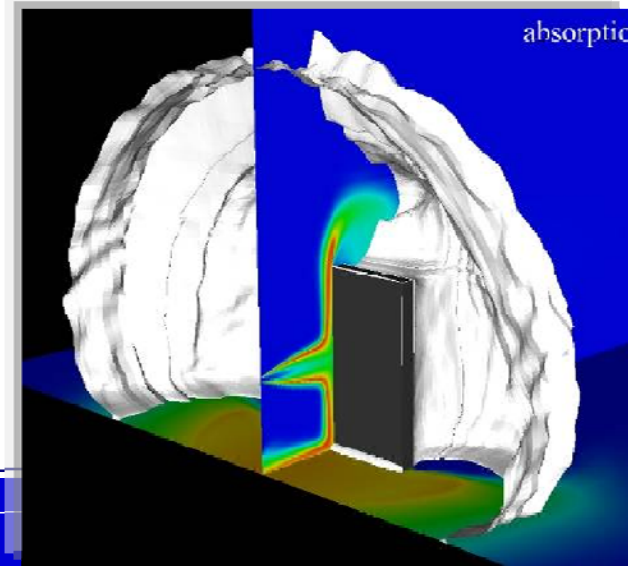
- Facilitated NFPA 2: Hydrogen Technologies Code Proposed Standard
  - Available for public comment
- Developed and implemented hydrogen installation permitting workshops
  - Over 250 code officials have been trained to date
- Coordinated the International Fuel Quality Specification, (ISO 14687-2) approved by ISO Technical Committee 197, March 1, 2008
  - ISO TS 14687-2 and SAE J2719 harmonized
- Developed an online course for researchers on hydrogen safety
- Designed a fuel cell vehicle prop for hands-on training of first responders
  - First hands-on training Conducted - May 2009



## *Integrated Risked- Informed Approach into NFPA code*

### **Accomplishments**

- Adopted Risk-Informed approach for Separation Distances into NFPA 55 2009 code
- Determined how barrier walls affect consequences of high-pressure gaseous release hazards using a risk-informed approach
- Introduced risk-informed decision making into the NFPA code development process
- Developed risk-informed permitting tools for NFPA 55 and NFPA 2

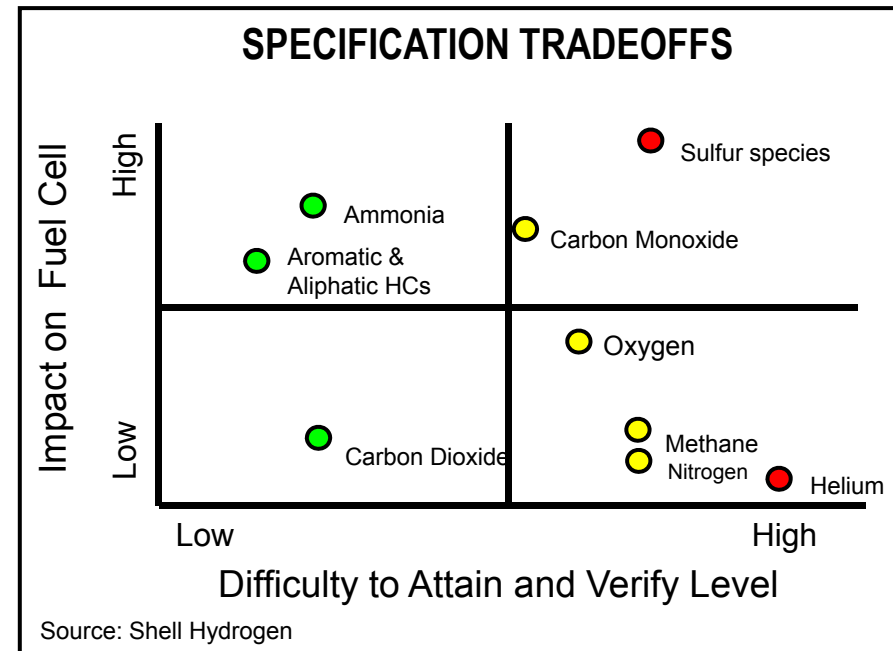




## *Fuel Quality - On schedule for a 2010 ISO Hydrogen Fuel Product Specification Standard*

### Accomplishments

- Approved and published ISO Technical Specification (TS 14687-2)
  - Committee Draft (CD) for International Standard under review
  - ISO TS 14687-2 and SAE J2719 are harmonized
- Adopted a Test protocol, test matrix, data reporting format
  - Testing priorities identified and adopted
  - Collaborative testing underway at LANL, HNEL, USC, Clemson-SRNL, UConn
  - Testing coordinated with Japan, Korea, and EU
- Standardized sampling and analytical methodologies under development by ASTM
  - Hydrogen Quality Sampling Apparatus (HQSA) to support ASTM test methods developed and safety-tested
- Applied Fuel cell stack and PSA models to support testing and to address fuel quality-fuel cost tradeoffs
  - Testing and modeling coordinated to help address effects of key contaminants on fuel cell performance
  - Potential canary constituent identified (CO) to simplify testing and analytical monitoring.







## National Template: Vehicle Systems & Refueling Facilities

### STANDARDS DEVELOPMENT ORGANIZATIONS

— LEAD STANDARDS DEVELOPMENT ORGANIZATIONS (SDOs)

Interface

#### Vehicles

##### CONTROLLING AUTHORITIES:

**DOT/NHTS** (crashworthiness)  
**EPA** (emissions)

##### General FC Vehicle Safety:



##### Fuel Cell Vehicle Systems:



##### Fuel System Components:



##### Containers:



##### Reformers:



##### Emissions:



##### Recycling:



##### Service/Repair:



## National Template: Stationary & Portable Systems

### STANDARDS DEVELOPMENT ORGANIZATIONS

— LEAD STANDARDS DEVELOPMENT ORGANIZATIONS (SDOs)

#### Hydrogen Generator

##### CONTROLLING AUTHORITIES:

**EPA** (emissions)  
**DOT/PHMSA** (pipeline)  
**OSHA, State and Local Gov't**  
(zoning, building permits)

##### Electrolyzers:



##### Reformers:



##### Perform. Test Procedures:



##### Chemical Hydrides:



#### Portable Fuel Cells

##### CONTROLLING AUTHORITIES:

**CPSC, DOT/PHMSA,**  
**OSHA, EPA** (methanol)  
**State and Local Government**  
(zoning, building permits)

##### Handheld Systems:



##### Portable Systems:



##### Handheld Fuel Containers:



##### Portable Fuel Containers:



##### H<sub>2</sub> Fuel Specifications:



##### Perform. Test Procedures:



#### Stationary Fuel Cells

##### CONTROLLING AUTHORITIES:

**OSHA, State and**  
**Local Government**  
(zoning, building permits)

##### H<sub>2</sub> ICEs:



##### H<sub>2</sub> Fueled Turbines:



##### FC Systems:



##### FC Installation:



##### FC Performance Test Procedures:



#### Interface

##### Installation Piping:



##### Storage:



##### Compressors Safety Cert.:



##### Comp. Design, Perf. & Safety:



##### Sensors/Detectors:



##### Fuel specifications:



##### Weights/Measures:



##### Dispensers:



##### Non-vehicle Dispensing:



##### Codes for Built Environ.:



##### Interconnection:







U.S. DEPARTMENT OF ENERGY

## Hydrogen Program

hydrogen.  
**energy.gov**

SEARCH PERMITTING

[Search Help](#)

### Permitting Hydrogen Facilities

- > **Permitting Process**
- > **Codes & Standards Search**
- > **Hydrogen Fueling Stations**
- > **Telecommunication Fuel Cell Use**

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](#).


U.S. DEPARTMENT OF ENERGY

about [hydrogen basics](#).

Also affecting the design and permitting of hydrogen fueling stations are the methods used for hydrogen acquisition, storage, compression, and dispensing. Learn more about:

- [Hydrogen delivery](#)
- [On-site hydrogen production](#)
- [Hydrogen storage and compression](#)
- [Hydrogen dispensing](#)
- [Design Standards](#)
- [Operation Standards](#)

> **Telecommunication Fuel Cell Use**



hydrogen.  
**energy.gov**

SEARCH PERMITTING

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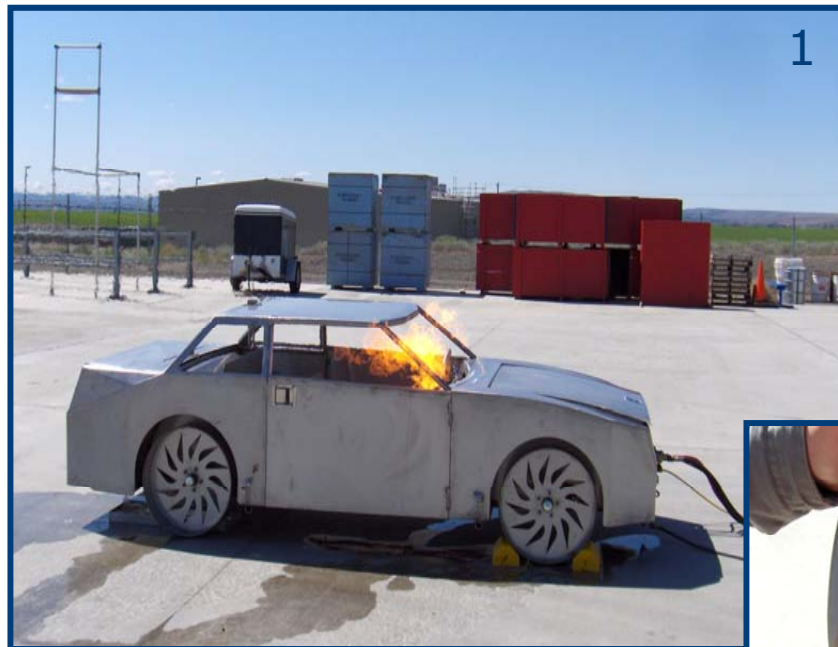
Some cars can be fueled at the stations.



This fueling station in Washington, D.C., provides drivers with both hydrogen and gasoline fuels



*First hands-on training conducted - May 2009*



(1) A propane flame simulates a compartment fire

1



2



3



4

Training prop features: (2) mock fuel cell stack, (3) mobile capability, (4) mock hydrogen storage tank.



- Firefighters, safety experts, fire marshals, hydrogen experts, OEM's, Energy Companies and Industry have participated and contributed to the course development.

## Updated and Improved Safety Databases

## Published First Quarterly Safety Newsletter

The image displays three overlapping screenshots of safety databases. The top screenshot shows the 'H2Incidents' website with a 'Welcome!' message and a search bar. The middle screenshot shows the 'H2 Safety Best Practices' website with a 'Welcome!' message and a search bar. The bottom screenshot shows the 'Hydrogen Safety Bibliographic Database' website with a 'Welcome!' message and a search bar. Each screenshot is accompanied by its respective URL in a blue box.

**H2Incidents**  
Hydrogen Incident Reporting and Lessons Learned  
[www.h2incidents.org](http://www.h2incidents.org)

**H2 Safety Best Practices**  
[www.h2bestpractices.org](http://www.h2bestpractices.org)

**Hydrogen Safety Bibliographic Database**  
[www.hydrogen.energy.gov](http://www.hydrogen.energy.gov)

## Newsletter to share safety information relevant to the Program

The image shows the cover of the 'H2 Safety Snapshot' newsletter. The cover features the title 'H2 SAFETY Snapshot' in a stylized font, with 'Vol. 1, Issue 1, Mar. 2009' below it. The main text describes the newsletter as a quarterly bulletin that highlights safety as an important element when working with hydrogen and hydrogen systems. It mentions that the newsletter contains a bibliography, glossary, and acronym, and that best practices are organized in hierarchical categories. The cover also includes a section titled 'CAPTURING a Wealth of Experience' and another titled 'LEARNING Lessons from Safety Events'. At the bottom, there is a section titled 'Link Up with Hydrogen' which lists the H2 Safety Best Practices, H2 Incident Reporting and Lessons Learned, and the Hydrogen Safety Bibliographic Database. The cover also features a small image of a computer monitor displaying the H2Incidents website.

**H2 SAFETY Snapshot**  
Vol. 1, Issue 1, Mar. 2009

H<sub>2</sub> Safety Snapshot is a quarterly bulletin that highlights safety as an important element when working with hydrogen and hydrogen systems. This inaugural issue discusses several safety tools related to the safe use and handling of hydrogen. We envision that H<sub>2</sub> Safety Snapshot will promote our continued success in the safe operation of DOE hydrogen projects.

— Patrick Davis  
Vehicle Technologies Program Manager

— Jaehon Milliken  
Hydrogen Program Manager

**Link Up with Hydrogen**

**H2 Safety Best Practices**  
www.h2bestpractices.org

**H2 Incident Reporting and Lessons Learned**  
www.h2incidents.org

**Hydrogen Safety Bibliographic Database**  
www.hydrogen.energy.gov/biblio\_database.html

**DOE Hydrogen Program**  
www.hydrogen.energy.gov

**SEARCHING the Literature**  
The Hydrogen Safety Bibliographic Database provides references to reports, articles, books, and other resources on hydrogen safety as it relates to hydrogen production, storage, distribution, and use. In addition to bibliographic references, the database provides select full-text documents or links to other websites that offer these documents. Visit [www.hydrogen.energy.gov/biblio\\_database.html](http://www.hydrogen.energy.gov/biblio_database.html) or contact us at [hydrogen\\_biblio\\_database@nsl.gov](mailto:hydrogen_biblio_database@nsl.gov)

PNNL-SA-45309

Topic suggestions? Comments?  
Contact us at [scapach@pnl.gov](mailto:scapach@pnl.gov)

A safety knowledge tool from

U.S. DEPARTMENT OF  
**ENERGY**

Pacific Northwest  
NATIONAL LABORATORY





- Promote risk-informed approach for developing technically sound (and traceable) codes & standards
- Continue hydrogen installation permitting workshops for fire safety and building code officials
- Continue generation of technically validated performance data needed for development and revisions of codes and standards
- Complete testing and modeling to develop international hydrogen fuel quality standard by 2010
- Explore insurance requirements necessary for operating of hydrogen installations and fueling stations



## ***Safety, Codes and Standards***

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