U.S. Department of Energy Hydrogen Program

Safety, Codes and Standards

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2008 DOE Hydrogen Program
Merit Review and Peer Evaluation Meeting

June 9, 2008

Goal and Objectives

SAFETY:

Develop and implement the practices and procedures that will 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.

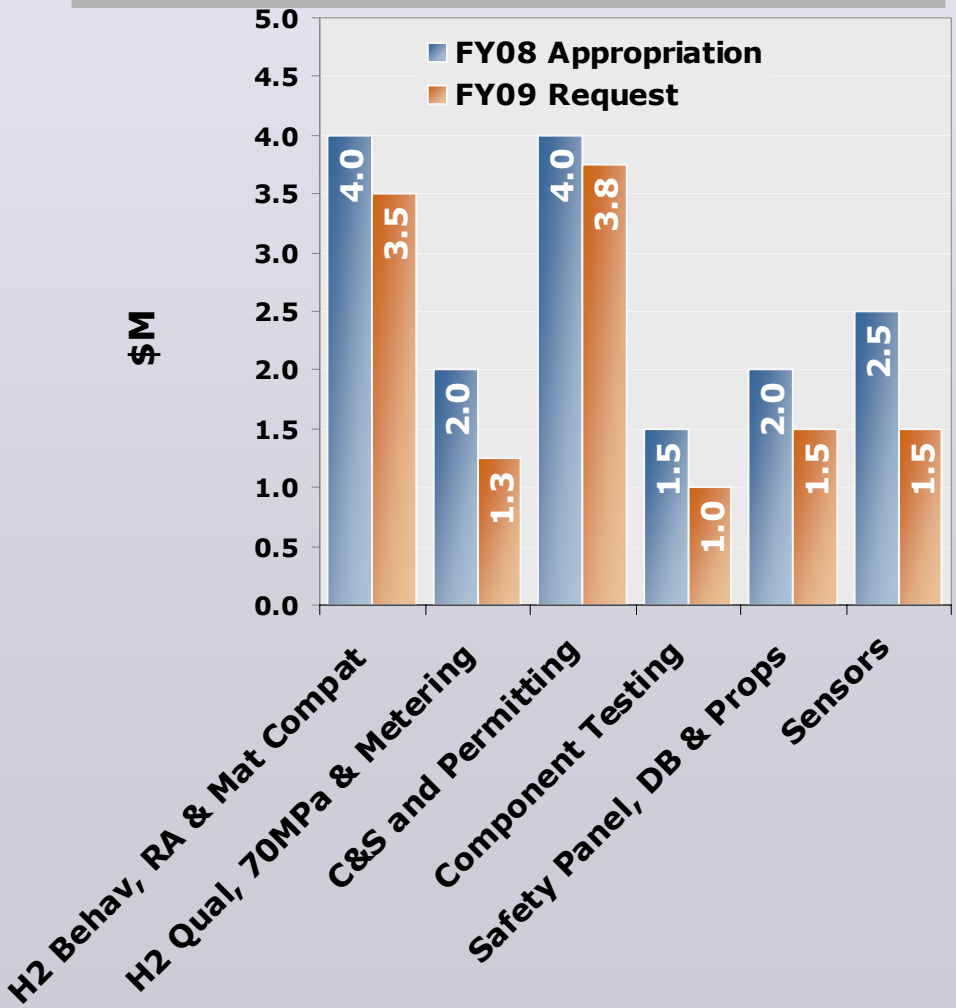
CODES & STANDARDS:

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.

Budget

FY2009 Budget (Request) = $12.5M

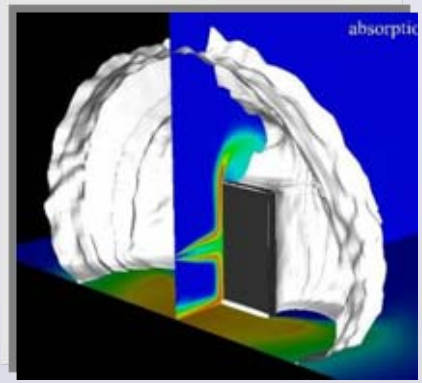
FY2008 Budget (Approp.) = $16.0M

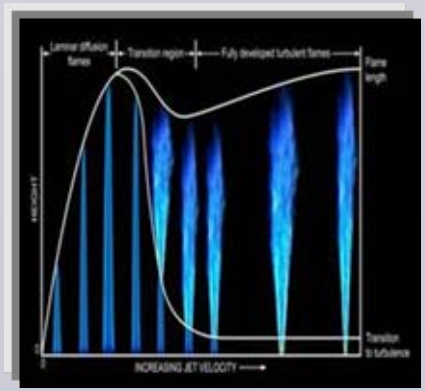


FY2009 Emphasis

- Technically validated performance data needed for new codes and standards
- Web-based 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

Challenges





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

2008 Progress & Accomplishments

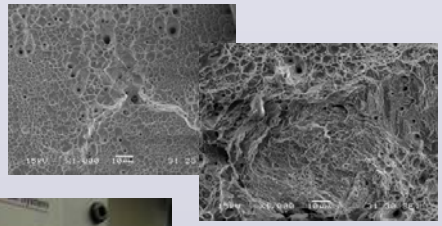
Launched Online Hydrogen Fueling Station Permitting Compendium *February 2008*

- International Fuel Quality Specification (ISO 14687-2) approved by ISO Technical Committee 197, March 1, 2008
  - ISO TS 14687-2 and SAE J2719 harmonized
- Succeeded in the adoption of risk-informed approach for the incorporation of hydrogen provisions in the next cycle of NFPA code development
- Designed, built and tested a fuel cell vehicle prop for first responder training
- Developed an online course for researchers on hydrogen safety
- Released Hydrogen Safety Best Practices Manual, December 2007

Materials Compatibility

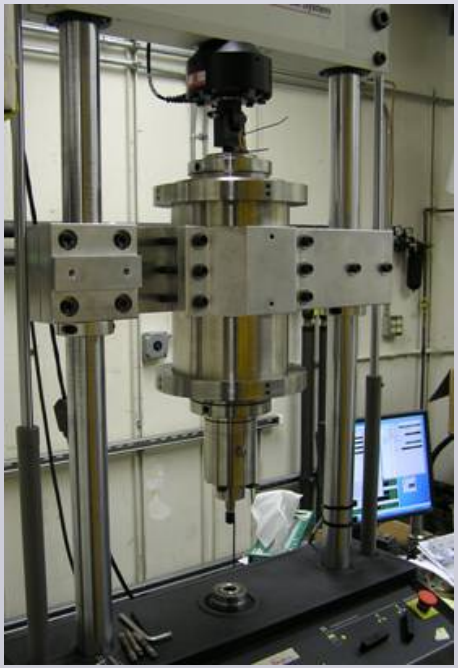
Goals

- Provide Technical Reference for Hydrogen Effects in Materials
- Measure cracking thresholds for static loads in high pressure gas
- Measure cracking thresholds for fatigue loads in high pressure gas



C&S Advocacy

- ASME Project Team on H2 Tanks
  - Section VIII, Div 3, KD-10
  - fracture mechanics in design
  - testing protocols
- ASME Project Team on H2 Piping and Pipelines
  - B31.12
- CSA NGV and HPRD
- SAE, vehicle component materials



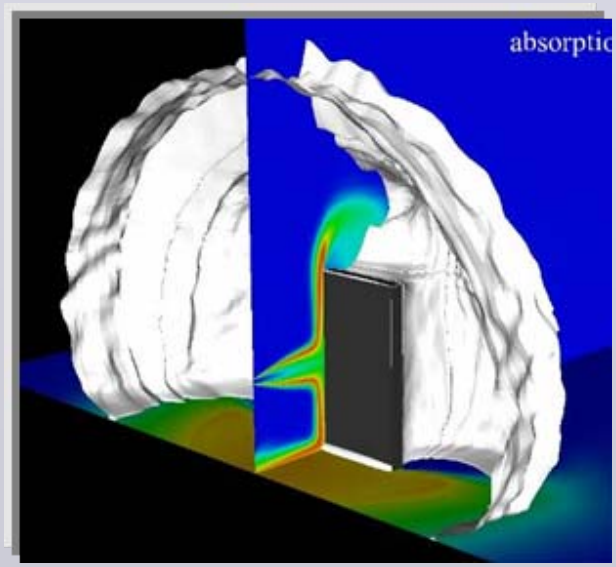
Barrier Wall Design

Goals

- Determine how barrier walls reduce or increase consequences of high-pressure gaseous release hazards using a risk-informed approach
- Develop models for jet flame interaction and over-pressure
- Perform validation experiments

C&S Advocacy

- NFPA 55 and NFPA 2
  - Risk-informed decision making
  - Unintended release characterization
- Hydrogen Industry Panel on Codes
- HYPER Stationary Fuel Cell Permitting
  - WP4 – model validation
  - WP5 – validation experiments



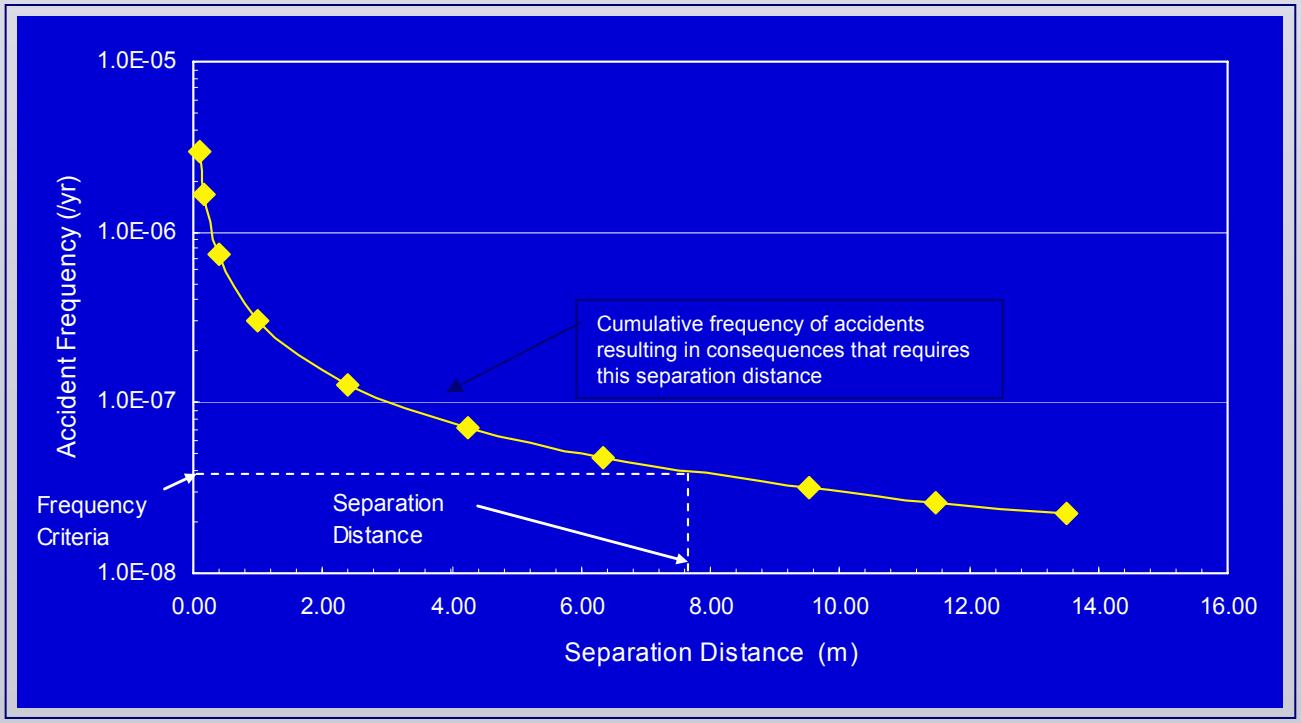
Quantitative Risk Assessment

Goals

- Introduce risk-informed decision making into the code development process
- Use quantitative risk assessment techniques to incorporate applied research and establish documented technical bases
- Provide risk-informed permitting tools

C&S Advocacy

- NFPA 55 and NFPA 2
- Hydrogen Industry Panel on Codes



National Template: Vehicle Systems & Refueling Facilities

STANDARDS DEVELOPMENT ORGANIZATIONS

LEAD STANDARDS DEVELOPMENT ORGANIZATIONS (SDOs)

Vehicles

CONTROLLING AUTHORITIES:
DOT/NHTS (crashworthiness)
EPA (emissions)

General FC Vehicle Safety: SAE
Fuel Cell Vehicle Systems: SAE
Fuel System Components: SAE
Containers: SAE
Reformers: SAE
Emissions: SAE
Recycling: SAE
Service/Repair: SAE

Interface

National Template: Stationary & Portable Systems

STANDARDS DEVELOPMENT ORGANIZATIONS

LEAD STANDARDS DEVELOPMENT ORGANIZATIONS (SDOs)

Hydrogen Generator

CONTROLLING AUTHORITIES:
EPA (emissions)
DOT/PMHSA (pipeline)
OSHA, State and Local Gov't (zoning, building permits)

Electrolyzers: UL, SAE
Reformers: UL, SAE, API
Perform. Test Procedures: ASME, SAE
Chemical Hydrides: UL, SAE, NFPA

Portable Fuel Cells

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

Handheld Systems: UL, SAE
Portable Systems: SAE, UL, G
Handheld Fuel Containers: UL, SAE, G
Portable Fuel Containers: G, SAE, ASME
H_2 Fuel Specifications: G, SAE
Perform. Test Procedures: gti, ASME, SAE

Stationary Fuel Cells

CONTROLLING AUTHORITIES:
OSHA, State and Local Government (zoning, building permits)

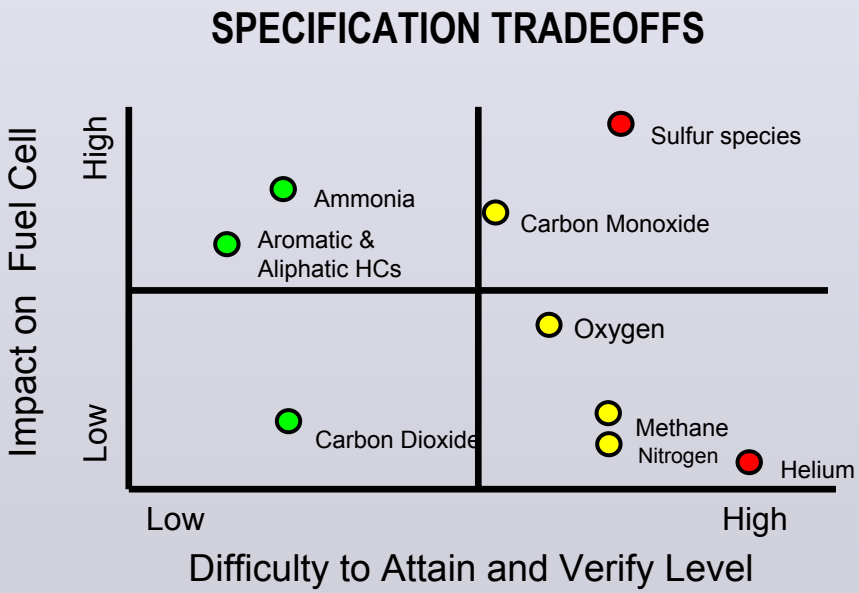
H_2 ICEs: UL, SAE
H_2 Fueled Turbines: API, SAE, UL, ASME
FC Systems: SAE, ASME, UL
FC Installation: NFPA
FC Performance Test Procedures: ASME, SAE, gti

Interface

Installation Piping: ASME, SAE, G, NFPA
Storage: ASME, G, SAE, API, NFPA
Compressors Safety Cert.: SAE, UL
Comp. Design, Perf. & Safety: API
Sensors/Detectors: UL, SAE, NFPA
Fuel specifications: G, SAE, API, ASTM
Weights/Measures: NIST, API, ASME
Dispensers: NFPA, SAE, SAE, UL, API
Non-vehicle Dispensing: G
Codes for Built Environ.: NFPA, NFPA, G
Interconnection: IEEE, UL, NFPA

Fuel Quality

- ISO Technical Specification (TS 14687-2) approved and published.
- ISO TS 14687-2 and SAE J2719 are harmonized.
- Test protocol, test matrix, data reporting format adopted:
  - Testing underway at LANL, HNEI, USC, Clemson-SRNL, UConn.
  - Testing coordinated with Japan, Korea, and EU.
- Particulate matter evaluation underway (NREL and industry partners).
- Hydrogen Quality Sampling Apparatus (HQSA) to support ASTM test methods developed and applied.
- Potential canary constituent identified (CO) to simplify testing and analytical monitoring.



Source: Shell Hydrogen

Hydrogen Installation Permitting

U.S. DEPARTMENT OF ENERGY
Hydrogen Program

hydrogen.energy.gov

SEARCH FUELING

Search Help

Hydrogen Fueling Station Codes and Standards

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

Hydrogen Fueling Stations Codes and Standards Search

Search for hydrogen fueling station-related codes and standards by issuing organization, codes and standards document, and/or topic.

Organizations and Documents

Select one or more organizations or codes and standards.

- American Society
  - ASME B31.3, F
  - ASME B31.8, G
  - ASME B31.8S,
- Compressed Gas
  - CGA G-5.4, Sta
  - CGA G-5.5, Hy
  - CGA P-1, Safe
  - CGA P-12, Safe
  - CGA PS-20, Di
  - CGA PS-21, Ad
  - CGA S-1.1, PRI
  - CGA S-1.2, PRI
  - CGA S-1.3, PRI
- International Cod
  - International Fir
  - International Fu
- National Fire Prot
  - NFPA 30A, Coc
  - NFPA 52, Vehic
  - NFPA 55, Stan in Portable and
- Society of Autom
  - SAE J2600, Co

Topics

U.S. DEPARTMENT OF ENERGY
Hydrogen Program

hydrogen.energy.gov

SEARCH FUELING

Search Help

Hydrogen Fueling Station Codes and Standards

- Hydrogen Fueling Home
- Hydrogen Fueling Stations
- Permitting Process
  - Zoning
  - Site Selection
  - Community Buy-In
  - Design, Equipment, & Construction
  - Transportation
  - Operation Approvals
  - Annual Inspections
- Codes & Standards Search
- Related Links
- Contacts

Hydrogen Fueling Station Permitting Process

The hydrogen fueling station permitting process details the steps, issues, codes, and standards that must be addressed by developers, permitting officials, fire safety officials, and other authorities to approve a station's operation.

The permitting process is designed to improve safety by reducing:

- The probability of an unintentional release of hydrogen
- The consequences of an accident if there is an unintentional hydrogen release
- The severity of a hydrogen-related fire.

The major steps of the hydrogen fueling station permitting process

The major steps of the permitting process include zoning; selecting a site; garnering community support; addressing station design, equipment, and construction requirements; transporting fuel; securing operation approvals; and, after operation begins, conducting regular inspections. Although the major steps of the process are listed sequentially here, they may vary significantly by project. Some projects may include more steps, and there may be overlap among the steps, depending on the procedures used by the local permitting authority. In addition, the steps may vary based on the type of hydrogen fueling station being developed. For example, the addition of hydrogen fuel to an existing gasoline station may have different zoning and site selection steps than a new standalone hydrogen fueling station. Similarly, stations that produce hydrogen on-site and stations that have hydrogen delivered may have different processes and requirements.

The last four steps of the hydrogen fueling station permitting process are based on hydrogen-related codes and standards. These codes and standards have been created by independent organizations to provide safe practices and procedures for developing, operating, handling, and using hydrogen and hydrogen-related systems. The codes and standards included in the permitting process outlined here are:

- ASME B31.3, Process Piping (2006)
- ASME B31.8, Gas Transmission and Distribution Systems (2003)
- ASME B31.8S, Managing System Integrity of Gas Pipelines (2004)
- CGA G-5.4, Standard for Hydrogen Piping Systems at Consumer Locations (2005)
- CGA G-5.5, Hydrogen Vent Systems (2004)
- CGA P-1, Safe Handling of Compressed Gases in Containers (2006)
- CGA P-12, Safe Handling of Cryogenic Liquids (2005)
- CGA PS-20, Direct Burial of Gaseous Hydrogen Storage Tanks (2006)
- CGA PS-21, Adjacent Storage of Compressed Hydrogen and Other Flammable Gases (2005)

Fuel Cell Vehicle Training Prop

Future Plans

- Continue hydrogen installation permitting workshops for fire safety and building code officials
- Evaluate current status of hydrogen leak detection technologies and release competitive solicitation for the development of state-of-the-art hydrogen safety sensors
- Conduct testing and modeling to develop international hydrogen fuel quality standard
- Continue generation of technically validated performance data needed for new and revised codes and standards
- Collect current hydrogen safety records and populate safety databases
- Promote risk-informed approach for developing technically sound (and traceable) codes & standards
- Expand permitting compendium to include stationary fuel cell installations

For More Information

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