



U.S. DEPARTMENT OF  
**ENERGY**

# **Safety, Codes, and Standards**

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**2007 DOE Hydrogen Program  
Merit Review and Peer Evaluation Meeting**

**May 15, 2007**



# Outline

- Goals
- Budget
- Challenges
- Progress
  - Accomplishments/Status
- Future Plans



# Goals

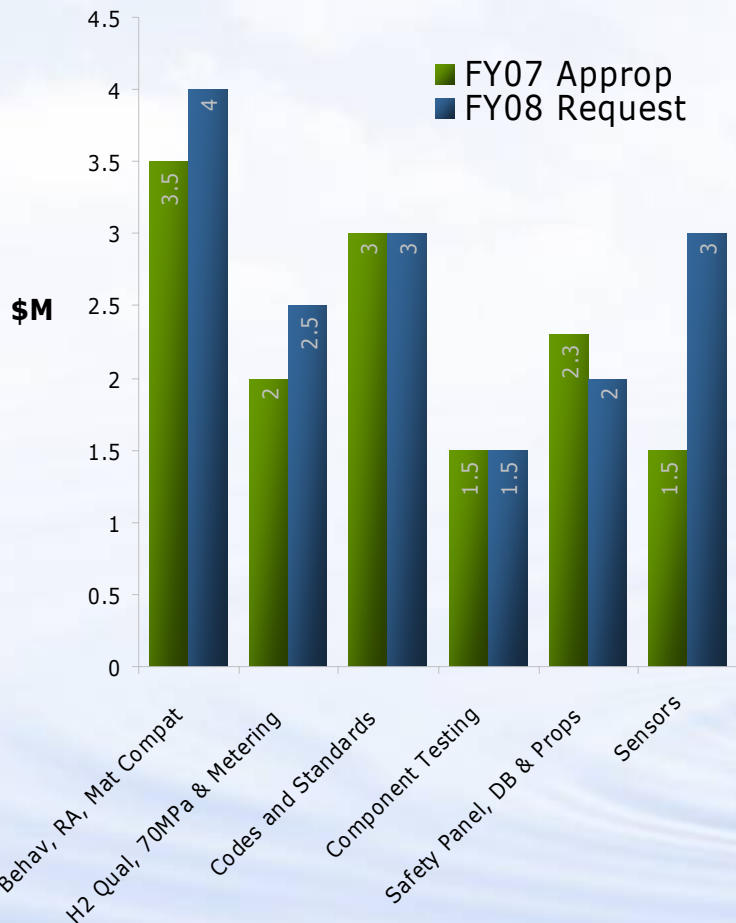
**Safety:** Develop and implement the practices and procedures that will ensure safety in the operation, handling, and use of hydrogen and hydrogen systems for all DOE-funded projects and utilize these practices and lessons learned to promote the safe use of hydrogen.

**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 development and harmonization of domestic and international codes and standards.



# Budget

FY 2008 Budget Request = \$16.0 M  
 FY 2007 Appropriation = \$13.8 M



## Emphasis

- Technically validated performance data needed for new codes and standards
- Permitting tools for siting of commercial refueling stations
- Hydrogen quality
- High-pressure refueling
- Conduct risk assessment and establish protocols to identify and mitigate risks
- Establish consensus R&D for global harmonization of hydrogen quality standards

## FY2008 Budget Plan:

H2 Behavior/Risk Assessment	\$ 4.0M
H2 Quality/70 MPa	\$ 2.5M
Codes and Standards	\$ 3.0M
Component Testing	\$ 1.5M
Safety Panel/Info. Tools	\$ 2.0M
Sensors	\$ 3.0M

**Total** \$16.0M



# Challenges



- Limited historical data / insufficient technical data to develop and revise standards
- Large number of Authorities Having Jurisdiction
- Lack of uniform training of officials
- Lack of standard practices for safety assessments
- Lack of integrated, coordinated approach among C&S Organizations
- Lack of harmonization of domestic and international standards
- Limited government influence on C&S process
- Limited DOE role in international C&S development process





# Progress Accomplishments/Status

- *Technical Reference for Hydrogen Compatibility of Materials (v.1.0) – complete*
  - <http://www.ca.sandia.gov/matlsTechRef/>
- Targets for stationary, on-board, and interface hydrogen safety sensors updated
  - Workshop conducted April 4, 2007
- Compendium of Permitting Tools
  - Hydrogen Fuel Station Permitting Workshop conducted
  - Case Studies Workshop to be conducted July, 2007
- Hydrogen Safety Panel
  - Conducted 22 safety reviews of production, storage, fuel cells and technology validation projects
  - Reviewed 60+ safety plans



# Progress Safety Information Tools

**H2Incidents**  
Hydrogen Incident Reporting Tool

Incident Report

Introduction of Stainless Steel Spatula Elicits Flame

11 January 2005

Severity:	Incident	Was Hydrogen released?	No	Was there ignition?	Yes
No Ignition Source Defined.					

Description

During preparation of a new hydrogen storage material, ammonia borane (AB) loaded onto mesoporous carbon, an unexpected incident was observed. As with all procedures with new materials the work is conducted on a small scale and in a laboratory fume hood. They followed the procedures that they had used for absorption of ammonia borane onto mesoporous silica without incident. To absorb the solid AB into a scaffold material they dissolve AB in a dry aprotic polar solvent THF. The saturated solution of AB in

## H2 Incidents Database

- Information on hydrogen incidents and lessons learned
- Over 100 incidents documented
- [www.h2incidents.org](http://www.h2incidents.org)

Introduction to Hydrogen Safety for First Responders

U.S. Department of Energy Hydrogen Program

EMERGENCY RESPONSE

INCREASE YOUR H<sub>2</sub>IQ

This section includes information to help you identify hydrogen equipment, vehicles, and related storage equipment; detect a hydrogen release; identify potential hazards; and take initial protective actions if you witness or need to approach an incident.

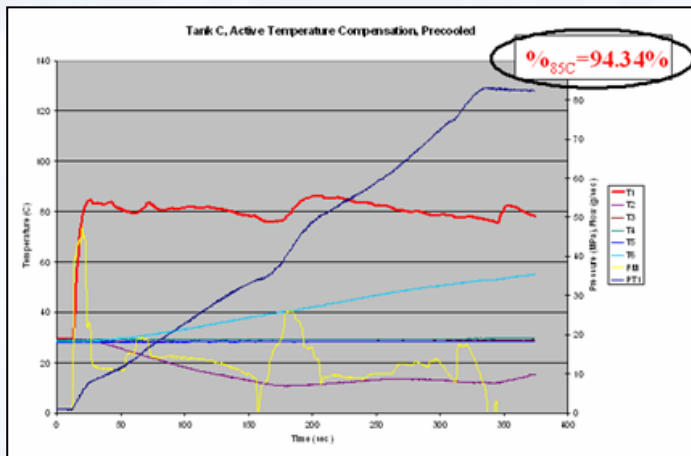
## H2 Safety For First Responders Course

- Hydrogen Basics
- Transport & Storage
- Hydrogen Vehicles
- Hydrogen Dispensing
- Stationary Facilities
- Codes & Standards
- Emergency Response

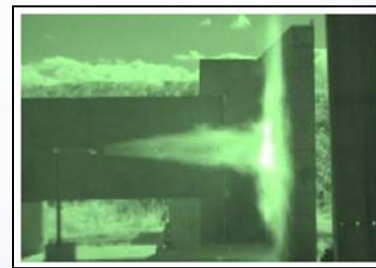


# Progress R&D

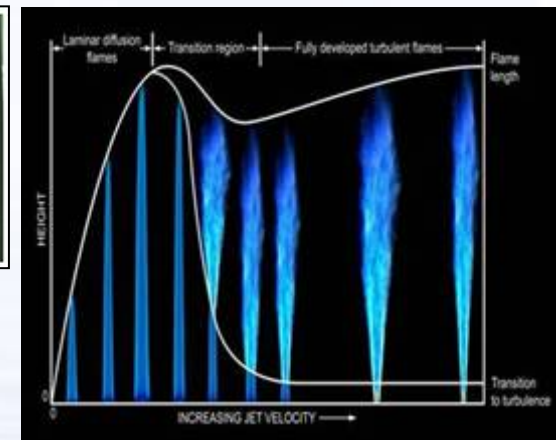
- High-pressure (70 MPa) refueling modeling and testing begun



- Results on hydrogen combustion and release scenarios published



Impinging jet, 10 ft impingement diameter



Flame Characterization

## Fuel Quality

- Specification tradeoffs identified
- Critical contaminants identified
- Composite test matrix compiled





# Future Plans

- Assess and improve the current state-of-the art for hydrogen safety sensors
- Publish a best practices manual for hydrogen safety
- Finalize hydrogen quality specification
- Expand efforts on hydrogen behavior, high-pressure refueling, and materials compatibility
- Grow the hydrogen safety and incidents databases
- Promote code development and permitting tools for commercial refueling stations
- Expand codes and standards activities for stationary and portable hydrogen and fuel cell systems



# For More Information

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The screenshot shows the homepage of the Hydrogen Program website. The header includes the U.S. Department of Energy logo and the text "Hydrogen Program" and "hydrogen.energy.gov". A navigation menu contains links for Home, About, DOE Participants, International, Library, and News/Events. A search bar is located in the top right corner. The main content area is divided into several sections:

- INCREASE YOUR H<sub>2</sub>IQ**: A section with a large "H<sub>2</sub>IQ" graphic.
- Announcement**: "Peer Evaluation Report Focuses on Merit of DOE Hydrogen and Fuel Cell Projects".
- News**: "Independent Review Panels Assess Progress Towards Technical Targets". The text below states: "Two new reports describe review panel findings related to cost targets for hydrogen production and fuel cells. October 5, 2006 [More >](#)".
- DOE Announces Hydrogen Funding Opportunity for Small Businesses**: "Small Business Innovation Research funding is available for evaluating hydrogen production and delivery technologies. September 27, 2006 [More >](#)".
- DOE Loan Guarantee Program Promotes Innovative Technologies**: "The DOE Loan Guarantee Program is available to promote the commercial use of innovative technologies. August 23, 2006 [More >](#)".

On the right side of the page, there are several featured sections:

- DOE Hydrogen Program**: A large graphic with "H<sub>2</sub>" and a yellow swoosh.
- Features**: "President's Hydrogen Fuel Initiative" with a small photo of a man.
- ADVANCED ENERGY INITIATIVE**: A yellow banner with the text in a stylized font.
- Hydrogen.gov**: A light blue banner with the text in a serif font.
- FreedomCAR & Fuel Partnership**: A logo featuring a star and the text "FreedomCAR & Fuel Partnership".
- Information on**: A blue banner with a dropdown arrow and the text "Financial Opportunities".

A sidebar on the left lists various topics with right-pointing arrows:

- > Hydrogen Production
- > Hydrogen Delivery
- > Hydrogen Storage
- > Hydrogen Manufacturing
- > Conversion/Fuel Cells
- > Applications/Technology Validation
- > Safety
- > Codes & Standards
- > Education
- > Basic Research
- > Systems Analysis
- > Systems Integration

The U.S. Department of Energy logo is also visible in the bottom left corner of the website screenshot.

[www.hydrogen.energy.gov](http://www.hydrogen.energy.gov)