Hydrogen Safety Awareness, Knowledge and Training

presented by

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for the

DOE/Contractor Fire Safety Workshop

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Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

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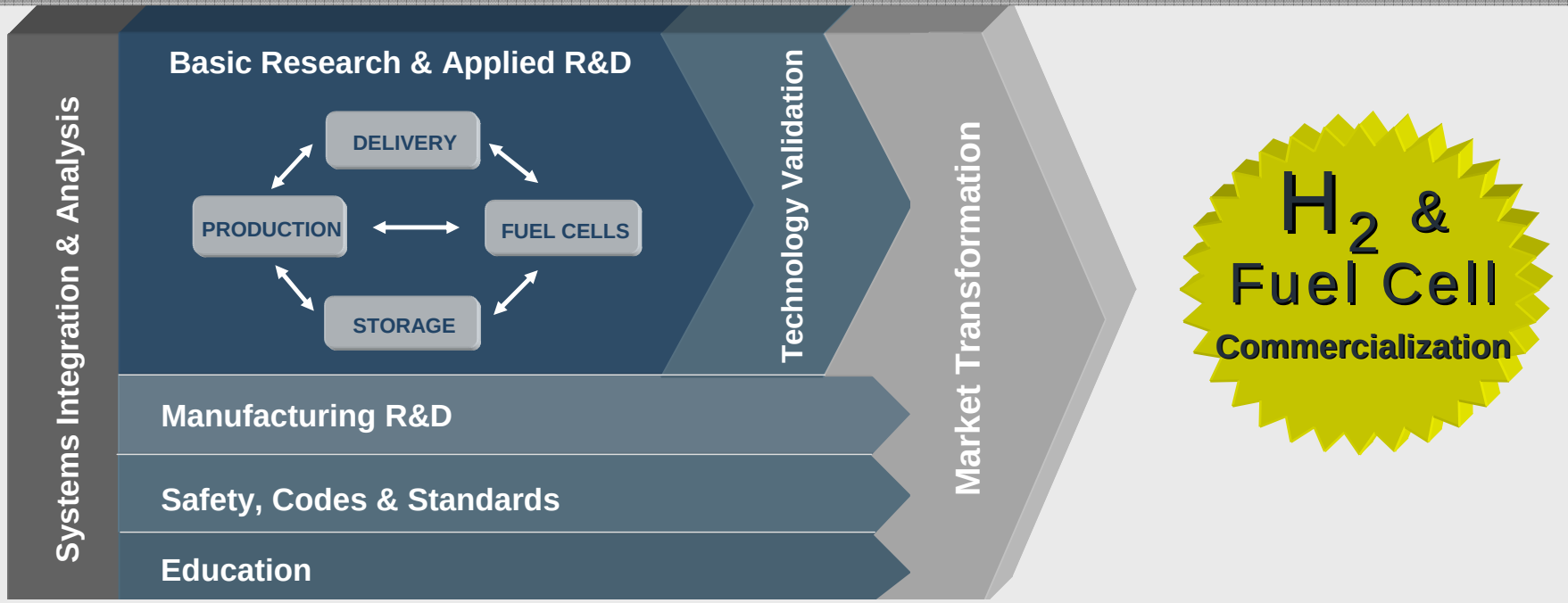
The DOE Hydrogen Program

The DOE Hydrogen Program is structured to address the wide range of barriers facing hydrogen and fuel cell commercialization



Hydrogen Safety Program Goal

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 hydrogen projects and utilize these practices and lessons learned to promote the safe use of hydrogen.

See www.eere.energy.gov/hydrogenandfuelcells/mypp/

- *Multi-Year Research, Development and Demonstration Plan: 2005-2015, October, 2007, Section 3.8.*

Hydrogen Education Program Goal

Educate key audiences about hydrogen and fuel cell technologies to facilitate near-term demonstration, commercialization and long-term market acceptance.

See www.eere.energy.gov/hydrogenandfuelcells/mypp/

- *Multi-Year Research, Development and Demonstration Plan: 2005-2015, October, 2007, Section 3.9.*

PNNL's Hydrogen Safety and Education Programs

- Hydrogen Safety Panel
- Incident Reporting and Best Practices
- Hydrogen Safety Training Props
- First Responder Education

One Hallmark of our Approach

Engage Panel members, OEMs, energy companies, international partners, first responders, code officials and other stakeholders in all aspects of our hydrogen safety and education programs

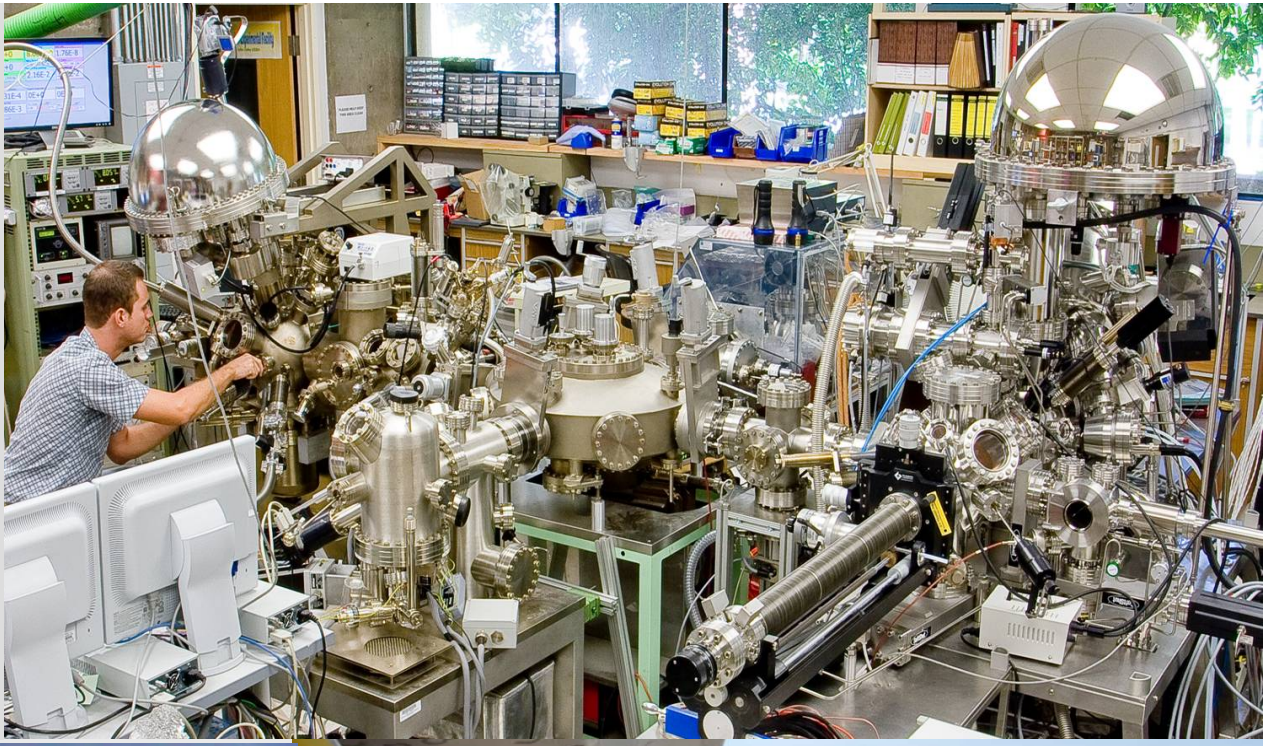
Hydrogen Safety Panel

- Provide expertise and guidance to DOE and assist with identifying safety-related technical data gaps, best practices and lessons learned
- Integrate safety planning into funded projects for DOE to ensure that all projects address and incorporate hydrogen and related safety practices

Don Frikken, Chair	Becht Engineering
Steven Weiner, Program Mgr	PNNL
Addison Bain	NASA (ret)
Harold Beeson	NASA White Sands Test Facility
David Farese	Air Products and Chemicals
Richard Kallman	City of Santa Fe Springs, CA
Michael Pero	Hydrogen Safety, LLC
Harold Phillippi	ExxonMobil Res and Eng
Glenn Scheffler	GWS Solutions of Tolland LLC
Andrew Sherman	Powdermet Inc.
Ian Sutherland	General Motors
Robert Zalosh	Firexplo
Nick Barilo, Technical Support	PNNL
Ed Skolnik, Technical Support	Energetics

Panel meeting hosted by NASA White Sands Test Facility, Las Cruces, NM

From Laboratory to Demonstration



Hydrogen Safety Panel For Good Measure…

145 safety plans reviewed

27 safety reviews conducted

4 "white paper" recommendations

4 "good example" safety plans

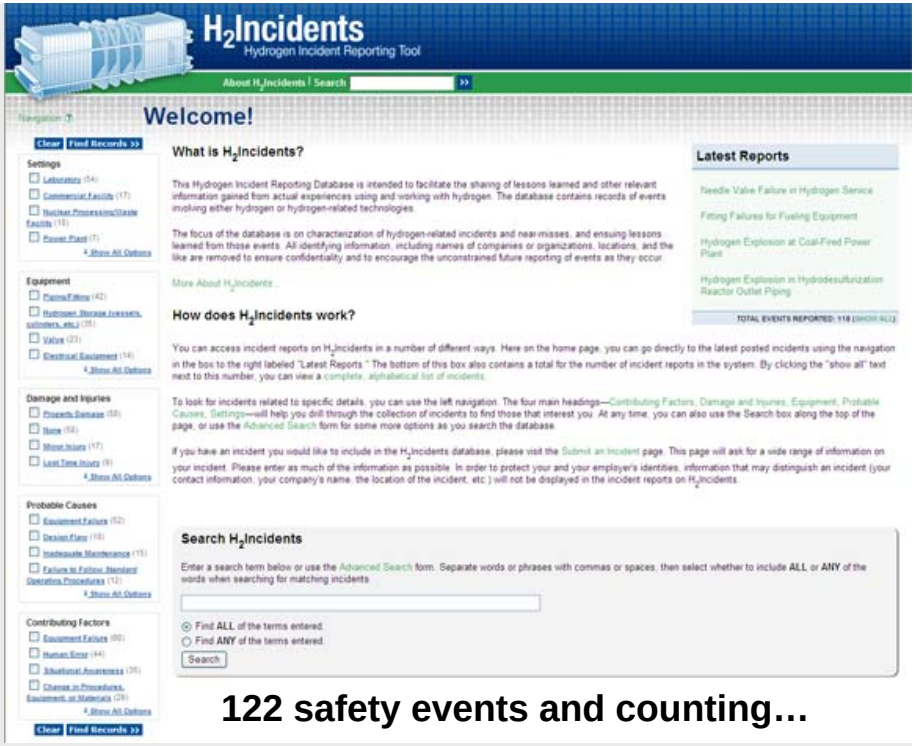
3 updates to safety guidance document

1 accident investigation

…in addition to providing expertise and review for the following work…

Hydrogen Incident Reporting and Lessons Learned (H2Incidents.Org)

A unique resource for sharing of safety events and lessons learned gained from actual experiences using and working with hydrogen



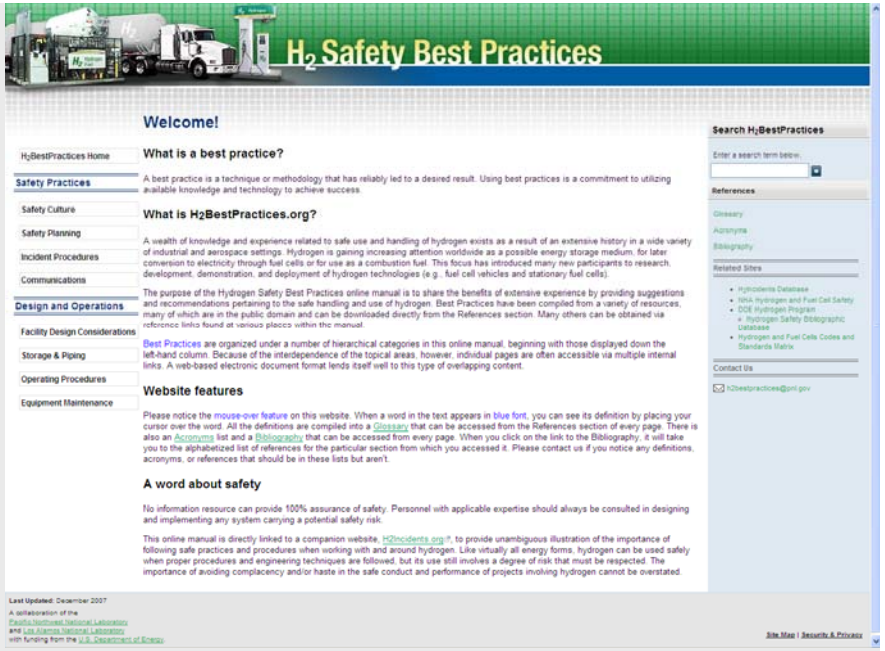
122 safety events and counting…

A Safety Event Record Captures

- Description
- Setting
- Equipment
- Characteristics
- Damage and Injuries
- Probable cause
- Contributing factors
- Lessons learned and mitigation steps

- Improving characterization of safety event records to enhance value
- Linking lessons learned and mitigation steps to H2BestPractices.Org
- Designing a news alert feature for early capture of incident reports

Hydrogen Safety Best Practices
(H2BestPractices.Org)



Integrating extensive historical experience and learnings with technical expertise and related practices

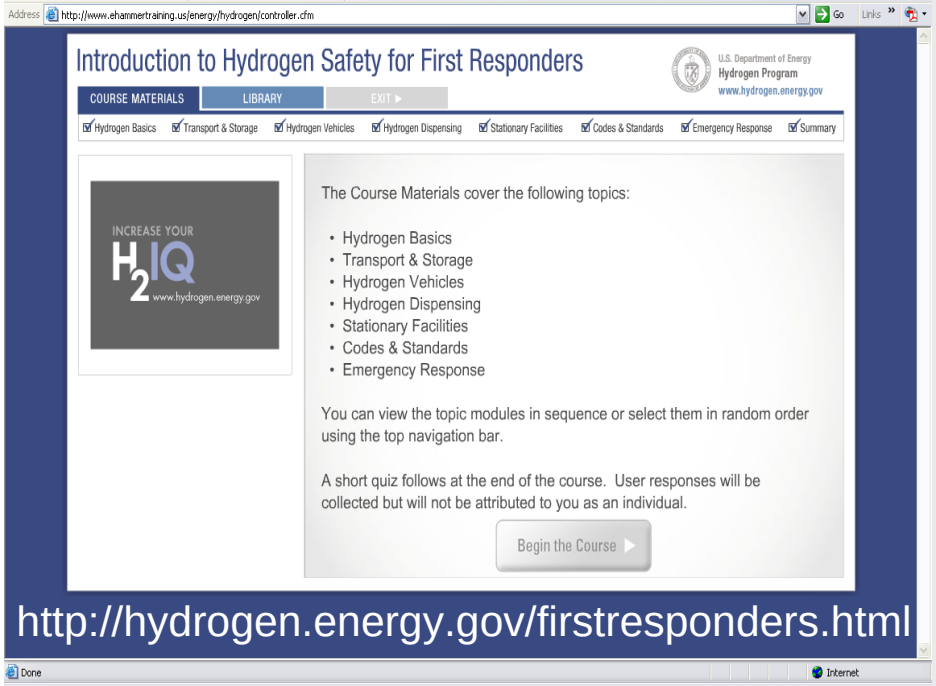
Safety Practices
- Safety Culture
- Safety Planning
- Incident Procedures
- Communications

Design and Operations
- Facility Design Considerations
- Storage and Piping
- Operating Procedures
- Equipment Maintenance

- Released by DOE in December 2007
- Responding to comments, adding material and developing new content
  - Hydrogen properties
  - Pump/compressor information
  - Laboratory safety (major new section)
    - Hydride handling and storage (Sandia)
- Linking content to safety event records in "H2Incidents.Org"

Volpentest HAMMER Training & Education Center

- Established 1997 at the Hanford Site, Richland, WA
- Named for community leader, Sam Volpentest
- Training
  - Fire Operations
  - Emergency Management
  - Law Enforcement
  - Occupational Safety & Health
  - Radiological Control
  - Others
- 20 classrooms and over 30 life-size, hands-on props
- *"Training as real as it gets!"*



Introduction to Hydrogen Safety for First Responders

A stand-alone, interactive, web-based "awareness-level" course

- Developed, reviewed, piloted and launched in January 2007
- Reviewed by over 100 representatives from the hydrogen and emergency-response communities
- 6,200 visitors since launch from almost every state and many foreign countries

PNNL and HAMMER conducted a pilot course in April 2006.

Current HAMMER Props

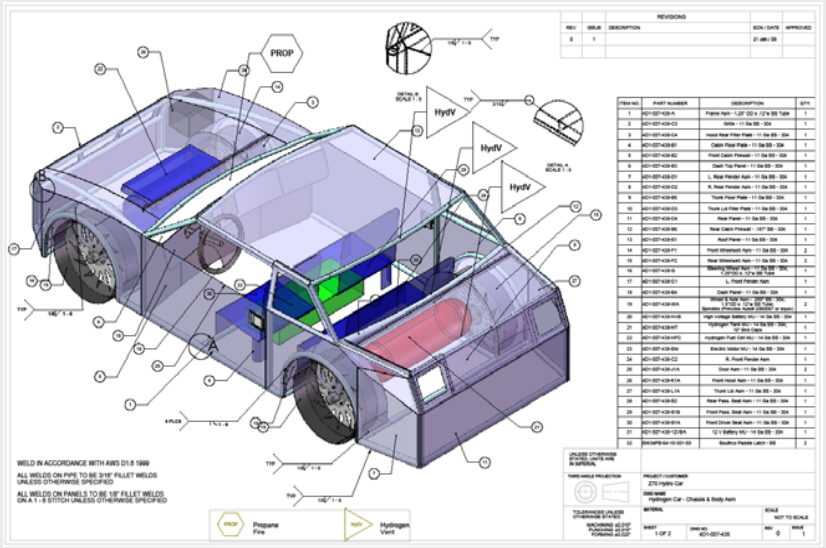
HAMMER's current propane-fired vehicle burn prop recreates conditions encountered during control and suppression of vehicle fires.

Demonstration prop illustrates differences between hydrogen and propane flame characteristics.

FCV Simulator Prop Integrated with Training Curriculum

- Demonstrate the use of hydrogen gas and flame detectors
- Demonstrate the safe approach to an FCV in the event of an incident
- Demonstrate extinguishment of a compartment fire
- Demonstrate extrication techniques
- Demonstrate hydrogen venting

This propane-fueled burn prop looks like the hydrogen FCV simulator prop that Kidde Fire Trainers will deliver to HAMMER in May 2008.



Prop-Based Course

- Develop and pilot a one-day course for first responders that uses a mobile hydrogen FCV prop
- Input provided by key stakeholders
  - Directors of regional firefighter training centers in CA, CT, FL, MI, NY, SC and TX
  - Steering committee representing OEMs, energy companies, hydrogen/FCV and firefighting organizations, national laboratory staff
- Key messages
  - Interest in hydrogen/FCV training, hosting course and participation in train-the-trainer course
  - Use existing and vetted materials as much as possible; teach what is the **same** and **different** about hydrogen and FCVs compared to conventional fuels and vehicles

Modules for Prop-Based Course

1. Introduction and Course Overview
2. Hydrogen and Fuel Cell Basics
3. Hydrogen-Fueled Vehicle Systems
4. Hydrogen-Related Stationary Facilities
5. Standard Operating Procedures
6. Practical Exercise
7. Quiz
8. Hands-On Exercise with FCV Prop

Other References and Contacts

U.S. Department of Energy Hydrogen Program

- www.hydrogen.energy.gov/

Safety Planning Guidance for Hydrogen Projects

- www1.eere.energy.gov/hydrogenandfuelcells/codes/oversight.html

Hydrogen Safety Bibliographic Database

- www.hydrogen.energy.gov/biblio_database.html

Volpentest HAMMER Training and Education Center

- www.hammertraining.com

Hydrogen Program Contacts

- Antonio Ruiz (Safety, Codes and Standards): (202) 586-0729, antonio.ruiz@ee.doe.gov
- Christy Cooper (Education): (202) 586-1885, christy.cooper@ee.doe.gov

Thank You!

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