

Hydrogen Education for Code Officials



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Energy Laboratory*

Hydrogen Technologies
& Systems Center

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Overview

T I M E L I N E

- *Start date:* October 2007
- *End date:* October 2010
- *Percent complete:* 80%

B U D G E T

Funding (100% DOE Funded)

- FY08: **\$255K**
- FY09: **\$130K**

B A R R I E R S

- Lack of Readily Available, Objective, and Technically Accurate Information (A)
- Disconnect Between Hydrogen Information and Dissemination Networks (C)
- Lack of Educated Trainers and Training Opportunities (D)

P A R T N E R S

- The Fire Protection Research Foundation
- Battelle
- ECommerce Systems
- e-learning Experts
- Code Officials
- Codes and Standards Technical Experts

Relevance— *Objectives*

Develop an introductory information (e-learning) package for code officials that specifically addresses safety, codes, and standards for hydrogen technologies, and facilitates demonstration and deployment projects.

Collaborations

Partners

- NREL is working with The Fire Protection Research Foundation, Battelle, ECommerce Systems, e-learning experts, code officials, and codes and standards technical experts to produce a high quality, technically accurate educational tool and disseminate the information in a productive manner.

Battelle
The Business of Innovation

ECS
ECommerce Systems

 THE
FIRE PROTECTION
RESEARCH FOUNDATION

Approach



Evaluate e-learning methods, tools, and software packages to determine the best way to present the information to code officials.



Develop a detailed outline and content of each module.



Work with codes and standards experts to ensure accurate and appropriate content.



Attend workshops for code officials to determine what information they need.



Disseminate the information through publications and electronically.

Approach

- Design e-learning resources to maximize usability.
- E-learning tools are most effective when the learner is engaged and interacting with the information on the screen.

Introduction to Hydrogen for Code Officials



COURSE MATERIALS

LIBRARY

EXIT >

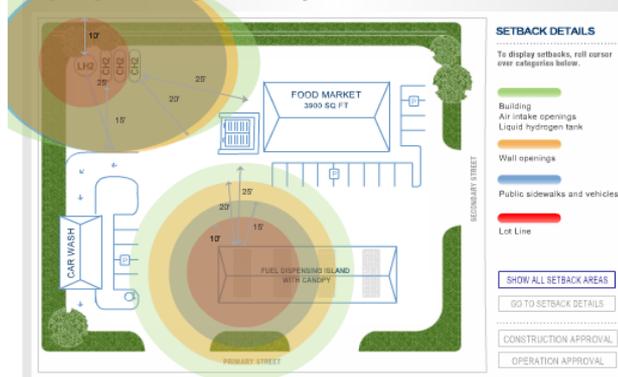
Hydrogen & Fuel Cell Basics

Hydrogen & Fuel Cell Applications

Permitting Hydrogen Fueling Stations

Permitting Stationary Facilities

Hydrogen Fueling Station Layout



Construction Approval

ASME B31.3, Process Piping (American Society of Mechanical Engineers, 2006)

- F323.4(5) Specific Material Considerations-Metals
- IX K305 Pipe
- IX K306 Fittings, Bends, and Branch Connections
- IX K307 Valves and Specialty Components

CGA G-5.4, Standard for Hydrogen Piping Systems at Consumer Locations (Compressed Gas Association, 2005)

- 3.0 Piping System Criteria
- 3.1 General
- 3.2 Piping Materials
- 3.3.2 Isolation Valves
- 3.3.3 Emergency Isolation Valves
- 3.3.4 Excess Flow Valves
- 3.3.5 Check Valves
- 3.3.7 Gasket and Sealing Materials
- 3.3.8 Additional Requirements
- 5.0 Installation
- 5.1 Installation General

This animation illustrates the International Fire Code setback requirements for hydrogen fueling stations.

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Technical Accomplishments and Progress

Milestones

October 2007 <i>✓ Complete</i>	Evaluate e-learning software, methods and tools. Determine the best application and method for presenting the information to code officials.
November 2007 <i>✓ Complete</i>	Organize content information and graphics for the first module (Introduction to Hydrogen).
December 2007 <i>✓ Complete</i>	Develop module 1 content and put into e-learning format. Submit for review.

Technical Accomplishments and Progress

Milestones

July 2008 ✓ Complete	Complete first four e-learning modules: <ul style="list-style-type: none">- Introduction to Hydrogen- Fuel Cell Applications- Hydrogen Codes and Standards- Permitting a Hydrogen Fueling Station
Sept. 2008 ✓ Complete	Complete the fifth module: <ul style="list-style-type: none">- Permitting Stationary Hydrogen Facilities, in series
Oct. 2008 ✓ Complete	Begin internal review.
March 2009 ✓ Complete	Begin external review among the hydrogen and code official community.
May 2009	Launch course on web site for public use.

Technical Accomplishments and Progress

MODULE 1

Hydrogen & Fuel Cell Basics

- Includes hydrogen properties, production, storage, and fuel cell basics.

Introduction to Hydrogen for Code Officials

U.S. Department of Energy
Hydrogen Program
www.hydrogen.energy.gov

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Hydrogen & Fuel Cell Basics Hydrogen & Fuel Cell Applications Permitting Hydrogen Fueling Stations Permitting Stationary Facilities

Hydrogen Basics

Although we never see it, hydrogen is everywhere in the world around us. It's the simplest element on Earth and the most abundant element in the universe.

A hydrogen atom consists of one proton and one electron. A hydrogen molecule consists of two hydrogen atoms, so hydrogen is often abbreviated as H₂. Hydrogen combines easily with other elements. On Earth, it's rarely found in pure form. Instead, it is found in combinations such as water, methane, and biomass.

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Comprehension of content
is tested with a module quiz.

Introduction to Hydrogen for Code Officials

U.S. Department of Energy
Hydrogen Program
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Hydrogen & Fuel Cell Basics Hydrogen & Fuel Cell Applications Permitting Hydrogen Fueling Stations Permitting Stationary Facilities

Codes and standards are being adopted, revised, or developed for the following:

- Vehicles
- Fuel delivery and storage
- Hydrogen generation
- Vehicle fueling interfaces
- All of the above

Check Answer Click on the Check Answer button.

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Technical Accomplishments and Progress

MODULE 2

Fuel Cell Applications

- Provides the learner with a detailed look at fuel cell applications.

MODULE 3

Permitting Hydrogen Fueling Stations

- Walks the learner through the permitting process and provides examples of station designs. Includes an animation of a typical station design with codes and standards that would apply along with the setback requirements.

MODULE 4

Permitting Stationary Facilities

- Describes fuel cell systems and walks the learner through the permitting process for these applications. An example of a telecom backup power application is provided.

Technical Accomplishments and Progress

The course was designed to automatically update the codes and standards when they are available.

LEARNING MODULES

Introduction to Hydrogen for Code Officials

U.S. Department of Energy
Hydrogen Program
www.hydrogen.energy.gov

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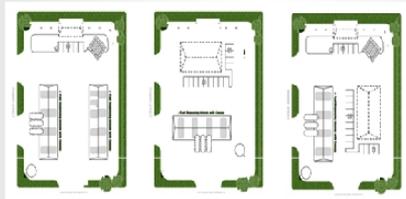
Hydrogen & Fuel Cell Basics Hydrogen & Fuel Cell Applications Permitting Hydrogen Fueling Stations Permitting Stationary Facilities

Construction Approval

A number of national codes and standards govern requirements for the general design and layout of hydrogen fueling facilities.

For example, model code provisions cover

- Fueling station design
- Equipment design (including listing and labeling)
- Barrier wall design, orientation, and construction
- Weather protection.



Designs for three hydrogen fueling station layouts.

To view examples of related hydrogen codes and standards, visit the links below:

- [Fueling station design](#)
- [Equipment design](#)
- [Barrier wall design](#)
- [Weather protection](#)

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Technical Accomplishments and Progress

Implementation

- Reaching the Target Audience
 - Identifying and understanding the Authority Having Jurisdiction (AHJ)
 - Presentations at organization membership meetings
 - Articles and Public Service Announcements for organization membership publications and websites
 - Training the trainer

Technical Accomplishments and Progress

Implementation – Working with AHJs on National Level

- National Association of State Fire Marshals (NASFM)
- International Fire Marshals Association (IFMA)
- PARADE (Info exchange network administrated by USFA)
- IAFC Fire & Life Safety Section Meeting (at IAFC Fire Rescue International)

Other organizations:

- International Code Council (ICC)
- National Fire Protection Association (NFPA)



Technical Accomplishments and Progress

Implementation – Working with AHJs on Local Level

- Every jurisdiction in U.S. is unique
- Working with AHJs on hydrogen applications
- Fire Code Officials (Fire Marshals and Fire Prevention Staff)
- Building Officials, and other code officials
- Planning and Zoning, Mechanical, Electrical
- AHJs for Federal or Tribal applications

Other AHJs:

- Public utility boards, insurance, etc...

Technical Accomplishments and Progress

The course is located at:

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



The screenshot shows the homepage of the Hydrogen Program website. At the top, it features the U.S. Department of Energy logo and the text 'Hydrogen Program' and 'hydrogen.energy.gov'. A navigation bar includes links for Home, About, DOE Participants, International, Library, and News/Events. A search bar is located on the right. The main content area is divided into several sections: a 'H₂IQ' section with the text 'INCREASE YOUR H₂IQ' and a description of the website's offerings; a 'News' section with three articles: 'DOE Releases a Hydrogen Sensor Funding Opportunity Announcement' (March 10, 2009), 'DOE Announces the 2009 Annual Merit Review and Peer Evaluation Meeting' (February 24, 2009), and 'DOE Issues a Request for Information: Hydrogen and Fuel Cell Market Transformation' (February 5, 2009); and 'DOE Reports to Congress on Fuel Cell School Buses and Hydrogen Fuel Cell Activities, Progress, and Plans' (January 30, 2009). On the right side, there are several featured images and links: 'DOE Hydrogen Program', 'Hydrogen.gov', 'FreedomCAR Fuel Partnership', 'Permitting Hydrogen Facilities - Fueling stations and fuel cell use for telecommunications', and 'Hydrogen Fueling Station Information'. A bottom navigation bar includes 'Information on' with links to 'Hydrogen Analyses & Models', 'Financial Opportunities', and 'Key Documents'. A circular callout graphic on the left side of the screenshot highlights the 'Codes & Standards' link in the left-hand navigation menu.

Proposed Future Work

Remainder of FY09

- Review the content and usability among the hydrogen and code official community.
- Complete the modules by adding audio and conducting beta testing.
- Disseminate web-based tools and other information to code officials through outreach activities, publications, and public service announcements.
- Consolidate DOE's online hydrogen education resources to provide a single location where information can be accessed.

Proposed Future Work

For FY10

- Continue to refine the e-learning module content and interactivity based on feedback received from the code official audience and reviewers.
- Update the information in each module as new information becomes available.
- Continue outreach activities.

Summary

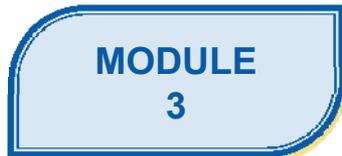
- An Introduction to hydrogen e-learning course has been developed targeting code officials. This work will be completed in FY10.



Introduction to Hydrogen



Fuel Cell Applications



Permitting Hydrogen Refueling Stations



Permitting Stationary Hydrogen Facilities