IX.8 Hydrogen Safety Education and Training for Emergency Responders

Bruce R. Kinzey
Pacific Northwest National Laboratory
901 D St., SW Suite 900
Washington, D.C. 20024
Phone: (202) 646-5231; Fax: (202) 646-5233
E-mail: Bruce.Kinzey@pnl.gov

DOE Technology Development Manager:
Christy Cooper
Phone: (202) 586-1885; Fax: (202) 586-9811
E-mail: Christy.Cooper@ee.doe.gov

Subcontractors:
Fluor Hanford, Richland, WA

Start Date: October 1, 2005
Projected End Date: September 30, 2008

Objectives

- Prepare emergency responder and other related safety communities for near-term hydrogen demonstrations and the long-term hydrogen economy.
- Develop hydrogen safety training and educational materials for first responders and code officials that can be used alone or "dropped in" to a wide variety of existing training activities, depending on the needs of the audience. Accomplish in close collaboration with relevant hydrogen and safety communities.
- Complete and release awareness-level educational materials for emergency responders who must be able to recognize a hydrogen incident and take initial protective measures.

Technical Barriers

This project addresses the following technical barriers from the Education and Safety sections of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

Education (3.8.4.1)

(A) Lack of Awareness

(C) Institutional Barriers and Access to Audiences

Safety (3.7.4.2)

(H) Lack of Hydrogen Knowledge by Authorities Having Jurisdiction

(I) Lack of Hydrogen Training Facilities for Emergency Responders

Technical Targets

This activity does not directly address technical targets from the R&D program. Rather, it is intended to enable preparation of a receptive environment for hydrogen and hydrogen technologies. Safe use of these technologies is essential, as is public perception that they can be safely used. A sufficiently prepared emergency response capability is critical to ensuring safety.

Accomplishments

- Developed draft awareness-level training curriculum, intended as an introduction to hydrogen safety for multiple safety-related audiences. Have incorporated much feedback received from various reviews.
- Conducted two separate sets of pilot courses; one (two sessions) in August, 2005; and the second (four sessions) in April, 2006. Test audiences included fire fighters, law enforcement, and code officials, among others; feedback has been very positive.
- Web-based version of curriculum planned for broad review in Summer 2006; final release to be issued shortly thereafter.

Introduction

Safety is a major priority for the U.S. Hydrogen Fuel Initiative. The National Hydrogen Energy Roadmap states that:

"Consumers may unnecessarily fear hydrogen if they are misinformed about its safety, and may hold misconceptions about the risk of using it in their homes, businesses, and automobiles. Fear may also stem from a lack of understanding about the dangers associated with fuels that consumers use today. The following message needs to be communicated: like all fuels, hydrogen can be handled and used safely with appropriate sensing, handling, and engineering measures."

In modern society, hazards associated with all fuel types are minimized through effective codes and standards regulating their use, and essential regulatory personnel who oversee such efforts. Unfortunately, no system can be made 100% risk-free despite the most diligent efforts. Accidents and system failures do occur, as illustrated by historical records of conventional fuels usage. Therefore, for any fuel, a suitably trained emergency response force is an essential component of a viable infrastructure.

Approach

Emergency responders (ERs) are a widely diverse group. ERs include fire fighters, law enforcement, emergency medical technicians, hazardous materials response teams, and others, all with very specific and separate duties and responsibilities upon arrival at the scene of an emergency situation. Even within a single ER category, such as fire fighters, there can be considerable variability, such as paid versus volunteer forces, rural versus urban settings, state funded versus paid by voluntary local contribution, and many other variations. In addition to ERs, other professions also play necessary roles in public safety, including code inspectors, state and local regulators and others who help ensure safe implementation of fueling infrastructure.

All of these personnel require a certain baseline of shared knowledge when it comes to common and ubiquitous hazards like transportation fuels. Certain of them require additional information beyond the fundamentals, depending on their specific role at the scene of an incident.

The current Education and Training activity is dedicated to providing an initial set of materials that pertain to hydrogen safety that can be adapted for use by all of these disparate groups in their preparations for future public use of hydrogen and hydrogen technologies. The ongoing approach employs the input of a diversity of experts in emergency responder training and hydrogen safety training, as well as individuals knowledgeable about various hydrogen using technologies (e.g., vehicle manufacturers) to produce a comprehensive set of educational materials for this purpose. These materials are to be available in a variety of formats in order to suit as many of the diverse needs of the safety community as possible. Materials are to follow a tiered approach developed by OSHA for hazardous materials training; this training has four levels that include Awareness, Operations, and Technician (and Specialist, which is not a focus of this activity), corresponding to the relative responsibilities expected of an ER at the scene of an incident.

Results

Several iterations of the first tier (Awareness-Level) training curriculum have been developed, reviewed, and subsequently modified to produce a series of updated and improved versions. This curriculum is now titled "An Introduction to Hydrogen Safety" and is intended to serve as an effective baseline of knowledge for all ERs as well as many other safety-related personnel. As these materials may comprise all the education and training that many audiences receive, they must convey the necessary information in a quick, easy to understand and easy to use format. The present version contains graphics, videos, computer animations and narration to facilitate the learning process and presents the technical content in as non-technical of manner as possible.

It is anticipated that the majority of target audiences accessing this curriculum will do so through the internet. Thus a "web-friendly" interface has been the focus of much attention. Other means by which this curriculum is to be made available include CD/DVD, video, live, and in hard copy formats. At this writing, the latest draft of these materials is set to undergo a widespread external review by numerous subject experts and stakeholders in the various relevant fields. Completion of the Awareness-Level curriculum is anticipated by Fall 2006, if no major issues arise from the widespread review. The completed curriculum will be available in all of the formats listed shortly thereafter.

Subjects explored in the Introduction to Hydrogen Safety include:

- Properties and potential hazards of compressed and liquid hydrogen
- Comparison with familiar fuels
- Standard design methods for safe hydrogen systems
- Hydrogen fuel cell vehicles, stationary applications, and refueling
- Recognition of hydrogen vehicles, signage and placards, packaging and storage
- Ignition sources
- Initial protective actions

Figures 1-3 provide example slides from different sections of the Awareness-Level curriculum. As noted, the full version of the curriculum also includes videos, computer animations, and narration to markedly enhance the learning experience.

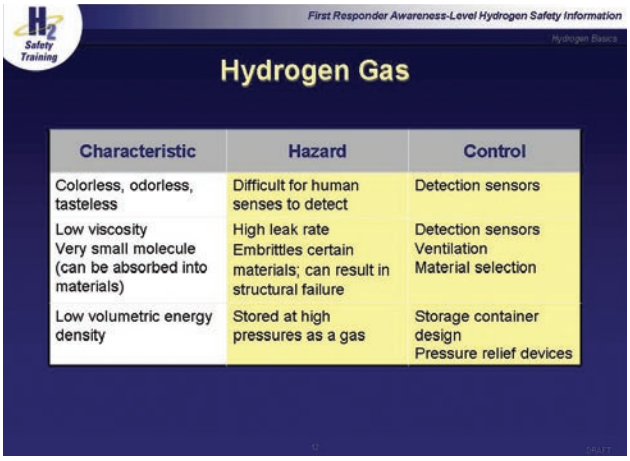

FIGURE 1. Hydrogen Gas Characteristics Example Slide

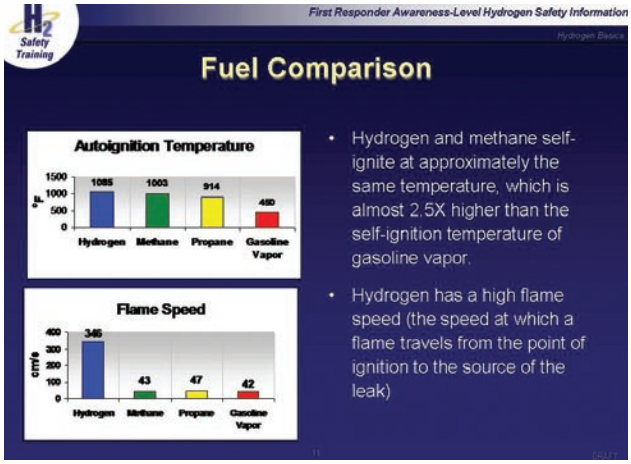

FIGURE 2. Fuel Comparison Example Slide

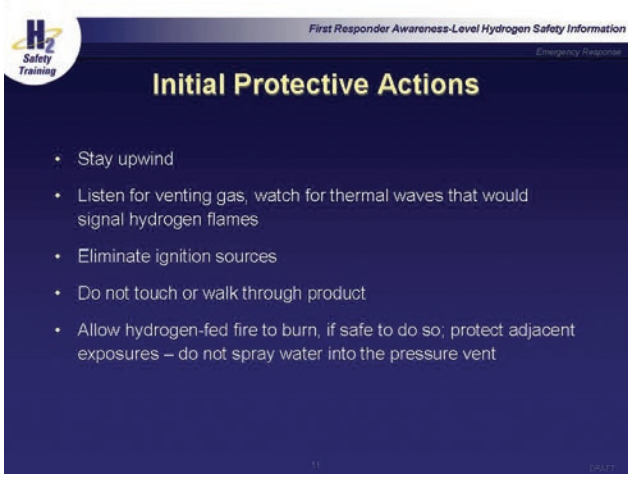

FIGURE 3. Initial Protective Actions Example Slide

Conclusions and Future Directions

Numerous organizations and individuals have expressed interest in the materials developed under this activity. Several have volunteered to act as reviewers in the upcoming external review, including a number that are internationally based. It is clear that the need for education and training materials and the importance of providing a prepared emergency response force is widely acknowledged within the hydrogen safety community.

Also evident is the fact that the availability of adequate hydrogen safety training and education materials is currently lacking. Although much disparate information exists from the decades of industrial and aerospace hydrogen use, this information has not yet been packaged in formats readily accessible to emergency responders and members of the general public. The current activity is thereby filling an important information gap that is crucial to the expanded use of hydrogen.

Finally, the interest expressed highlights the concern for accuracy in information and data provided for use by first responders and others. Voluntary participation by the various parties underscores the importance of the collaborative approach undertaken to date, soliciting and incorporating all relevant input through the pursuit of extensive reviews and pilot training classes.

Different audiences have varying requirements for the information they need, even though all are based on the same core set of data. A code official's information needs with respect to approving a proposed hydrogen refueling station, for example, are different from the corresponding needs of the builder of the proposed station, which are different from the insurance firm underwriting the installation, which differ from a fire fighter responding to a future incident at the station, which differ yet again from a member of the general public who lives in the neighborhood nearby. Eventually addressing all of these information needs will be essential for ensuring that such installations can proceed. This activity is expressly developing education and training materials for the various needs of first responders and code officials, but much of it may also eventually be useful for these other audiences as the need becomes more widespread.

FY 2006 Publications/Presentations

1. Fassbender, LL, Kinzey, BR and BM Akers. Safety Training for the Hydrogen Economy. 2006-01-0329. SAE World Congress 2006.

2. An Introduction to Hydrogen Safety – Awareness Level curriculum to be completed and released by September, 2006.

3. Four pilot courses of the draft curriculum conducted at HAMMER at the annual Washington State Patrol HazMat Workshop (April 1-2, 2006).

4. Hydrogen Safety Education and Training for Emergency Responders. 2006 Department of Energy Merit Review, May 17, 2006.

References

1. U.S. Department of Energy. Hydrogen Roadmap http://www.hydrogen.energy.gov/pdfs/national_h2_roadmap.pdf