
X.1 Hydrogen Safety Training for First Responders

Steven Weiner

Pacific Northwest National Laboratory (PNNL)
901 D Street SW, Suite 900
Washington, D.C. 20024
Phone: (202) 646-7870
E-mail: sc.weiner@pnl.gov

DOE Technology Development Manager:
Carole Read

Phone: (202) 586-3152
E-mail: Carole.Read@ee.doe.gov

Subcontractors:

- Volpentest HAMMER Training and Education Center, Richland, WA
Dennis McCall, James Bryan, Scott Jones
- California Fuel Cell Partnership (CaFCP), Sacramento, CA
Jennifer Hamilton

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Project End Date: Project continuation and direction determined annually by DOE

Objectives

- Support the successful demonstration and deployment of hydrogen and fuel cell technologies by providing technically accurate hydrogen safety and emergency response information to first responders.
- Provide a one-day first responder training course, "Hydrogen Emergency Response Training for First Responders," that integrates the use of DOE's mobile hydrogen fuel cell vehicle (FCV) prop (initial offering in Fiscal Year [FY] 2009).
- Continue to support the Web-based awareness-level course, "Introduction to Hydrogen Safety for First Responders," (initial offering in FY 2007).
- Disseminate first responder hydrogen safety educational materials at appropriate conferences to raise awareness.

Technical Barriers

This project addresses the following technical barriers from both the Education (ED) and Safety (SAF) sections of the Fuel Cell Technologies (FCT) Program Multi-Year Research, Development and Demonstration Plan:

- (A) Lack of Readily Available, Objective, and Technically Accurate Information (ED)

- (C) Disconnect Between Hydrogen Information and Dissemination Networks (ED)
- (D) Lack of Educated Trainers and Training Opportunities (ED)
- (H) Lack of Hydrogen Knowledge by Authorities Having Jurisdiction (SAF)
- (I) Lack of Hydrogen Training Facilities for Emergency Responders (SAF)

Contribution to Achievement of DOE Education Milestones

This project will contribute to achievement of the following DOE milestones from the Education section (3.9) of the FCT Program Multi-Year Research, Development and Demonstration Plan:

- Milestone 6: Update "prop-course" for first responders (4Q, 2011).
- Milestone 7: Update "awareness-level" information package for first responders (4Q, 2012).
- Milestone 9: Update "prop-course" for first responders (4Q, 2014).
- Milestone 10: Update "awareness-level" information package for first responders (4Q, 2015).

In addition, the following milestones were met in previous years:

- Milestone 1: Develop "awareness-level" information package for first responders (4Q, 2006).
- Milestone 3: Develop "prop-course" using hands-on training devices for first responders (4Q, 2008).
- Milestone 4: Update "awareness-level" information package for first responders (4Q, 2009).

Accomplishments

- **Prop-Based Course:** Three sessions were held at the Hazardous Materials Management and Emergency Response (HAMMER) facility in June 2009, August 2009, and April 2010 to train 66 students from 14 states. Extremely positive feedback reinforced the value of this course.
- **Awareness-Level Course:** Our Web site still averages 300-500 unique visits per month from almost every state and some foreign countries. We registered the course on the TrainingFinder Realtime Affiliate Network (TRAIN) Web site for broader dissemination to first responders. TRAIN is a central repository for public health training courses. Almost 30,000 TRAIN users identify themselves as emergency responders [1].

- **Outreach:** Compact discs (CDs) of the awareness-level course, laminated posters, and *Firehouse* article reprints were distributed through the DOE Energy Efficiency and Renewable Energy Information Center [2]. PNNL and HAMMER hosted booths at two key first responder conferences.



Introduction

Safety in all aspects of a future hydrogen infrastructure is a top priority, and safety concerns influence all DOE hydrogen and fuel cell projects. Despite the most concerted effort, however, no energy system can be made 100% risk-free. Therefore, for any fuel and energy system, a suitably trained emergency response force is an essential component of a viable infrastructure. The FCT Program Office has identified training of emergency response personnel as a high priority, not only because these personnel need to understand how to respond to a hydrogen incident, but also because firefighters and other emergency responders are influential in their communities and can be a positive force in the introduction of hydrogen and fuel cells into local markets.

This project is employing the Occupational Safety and Health Administration (OSHA) and National Fire Protection Association (NFPA) frameworks for hazardous materials emergency response training to develop a tiered hydrogen safety education program for emergency responders. The overall first-responder education program will be developed over a number of years. The effort started with development and distribution of the awareness-level Web-based course in FY 2006-2007. A more advanced course and materials to facilitate education were developed in FY 2008-2009, complementing the design, construction, and operation of a fuel cell vehicle prop (developed under PNNL's Hydrogen Safety project). In addition, PNNL has implemented outreach efforts to key stakeholder groups to facilitate delivery of the training to a broad audience.

Approach

PNNL works with subject matter experts in hydrogen safety and first responder training (e.g., the PNNL Hydrogen Safety Panel, other national laboratories, HAMMER, CaFCP), to develop hydrogen safety course materials. Draft materials are prepared and undergo considerable review and revision before being released. The PNNL team works with DOE to make stakeholder groups aware of training opportunities and to provide “live” training when appropriate. The prop-based course has been given at the HAMMER facility, but plans are in progress to deliver the course at

three training centers in California during 2010 in order to reach larger audiences in areas where hydrogen and fuel cell technologies are being deployed.

Results

Prop-Based Course: The focus of the curriculum is on teaching first responders what is the same and what is different about hydrogen and FCVs as compared to conventional fuels and vehicles. Course evaluation forms are distributed and feedback obtained at each class to help us improve the course content and delivery. Based on feedback from the three class sessions held this year (June 2009, August 2009, and April 2010), we concluded that first responders are comfortable with hydrogen and prepared to operate in a safe and effective manner, if a hydrogen incident should occur in their jurisdiction.

The FCV prop (shown in Figure 1) demonstrates potential conditions that could be encountered during the control and suppression of a FCV fire. The prop has been integrated into the “Hydrogen Emergency Response Training for First Responders” course developed by PNNL, HAMMER, and the CaFCP for DOE. The figure shows a team of firefighters responding to a multi-vehicle accident involving a hydrogen FCV and two conventional vehicles.

Web-Based Course: Since the online course was launched in January 2007, there have been more than 17,000 unique visitors to the Web site. The site is still averaging 300-500 unique visitors each month from almost every state and many foreign countries. Typical users include the fire prevention/protection community, firefighters, fire department education coordinators, fire marshals, fire plan examiners/inspectors, code officials, law enforcement officials, and representatives from industry, universities, the military, and non-profit organizations. Feedback on the course has been positive.



FIGURE 1. FCV Prop Training Exercise

Outreach: To distribute information and raise awareness about hydrogen safety and the DOE-sponsored courses, PNNL and HAMMER staff participated in two major first-responder conferences in FY 2010:

- Fire Department Instructor's Conference, April 2010, Indianapolis, IN.
- Fire Rescue International, August 2010, Chicago, IL.

Booths were set up to display and disseminate posters, announcements of course offerings, hydrogen safety literature, and awareness-level course CDs.

Conclusions and Future Directions

The introductory Web-based course has been quite successful, based on the usage recorded and feedback received. The course is fulfilling a need expressed by the first responder community to receive more information about hydrogen and fuel cells so they will be prepared in the rare event of a hydrogen incident. The in-depth prop-based course builds on that success and is very useful in giving first responders a hands-on experience with simulated FCV incidents that integrates well with classroom training. PNNL will continue to update both courses as needed to reflect current applications and markets for hydrogen and fuel cells.

There is an identified need for the prop course curriculum to achieve a better balance between the vehicles and stationary facilities modules, through the development of some type of prop for stationary applications of fuel cells. A virtual hydrogen fueling station model having dual capabilities to simulate both outdoor fueling of passenger FCVs and indoor fueling of hydrogen forklifts could address that need. We are planning to develop a virtual model with the following capabilities and attributes:

- Visualizations of outdoor and indoor hydrogen dispensing systems.
- Four configurations of hydrogen delivery/production (delivery of liquid hydrogen via tanker truck, delivery of gaseous hydrogen via tube trailer, onsite generation of hydrogen via natural gas reforming, and onsite generation of hydrogen via electrolysis).
- Text pop-ups describing the key components of outdoor and indoor hydrogen fueling stations (e.g., compressor, cylinder storage, dispenser).
- Animations of 30-second emergency response scenarios that could occur at outdoor and indoor fueling stations (e.g., various hydrogen leaks and fires).
- Narration of scripts for outdoor and indoor fueling scenarios.

The prop course will be offered at three first responder training facilities in California in FY 2010 (Sunnyvale Public Safety Department in Sunnyvale, Rio Hondo Community College Fire Academy in Santa Fe Springs, and the Orange County Fire Authority in Irvine). The prop will be transported to California in its trailer and left at each site for about a week. Three classes will be given at each site, resulting in a total of ~300 first responders trained. In future years, the prop will be transported to other locations across the country for use in delivery of this course at training centers in areas that have emerging deployments of hydrogen and fuel cell technologies. PNNL will also work with DOE and other stakeholders to determine what, if any, additional types of educational courses and materials are warranted, and to develop and implement plans to provide education to specific groups.

FY 2010 Publications/Presentations

1. Fassbender, L.L. June 9, 2010. "Hydrogen Safety Training for First Responders," PNNL-SA-72138, 2010 U.S. DOE Hydrogen Program and Vehicle Technologies Program Review and Peer Evaluation, Washington, D.C.
2. Weiner, S.C. June 10, 2010. "Hydrogen Safety Training for First Responders," PNNL-SA-72138, 2010 U.S. DOE Hydrogen Program and Vehicle Technologies Program Review and Peer Evaluation, Washington, D.C.
3. Fassbender, L.L. September 30, 2009. "H2 Safety Training for First Responders," PNNL-SA-68308, NextEnergy 2009 Hydrogen Codes and Standards Conference, Detroit, MI.

References

1. TrainingFinder Realtime Affiliate Network (TRAIN), <https://www.train.org>.
2. Linda Fassbender, Bret Akers, and Christy Cooper. August 2007. "Introduction to Hydrogen Safety for First Responders," www.Firehouse.com, pp. 158-159.