



HYDROGEN  
Emergency Response  
Education Program

# *First Responder Training Resources and Future Direction*

Steven C. Weiner

Pacific Northwest National Laboratory  
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# Today's talk

- ▶ Introducing our hydrogen safety program and the approach for first responder training
- ▶ Available training resources and current work on the national emergency response education program
- ▶ Reflections on a first responder training vision and the need to support the next phase of hydrogen fuel cell commercialization

# The PNNL Hydrogen Safety Program

## Hydrogen Safety Panel

- Identify safety-related technical data gaps
- Review safety plans and project designs
- Perform safety evaluation site visits
- Provide technical oversight for other program areas

## Safety Knowledge Tools

- *Hydrogen Lessons Learned from Incidents and Near-Misses* ([h2tools.org/lessons/](http://h2tools.org/lessons/))
- *Hydrogen Safety Best Practices* ([h2bestpractices.org](http://h2bestpractices.org))
- *Hydrogen Tools* (iPad/iPhone mobile application)

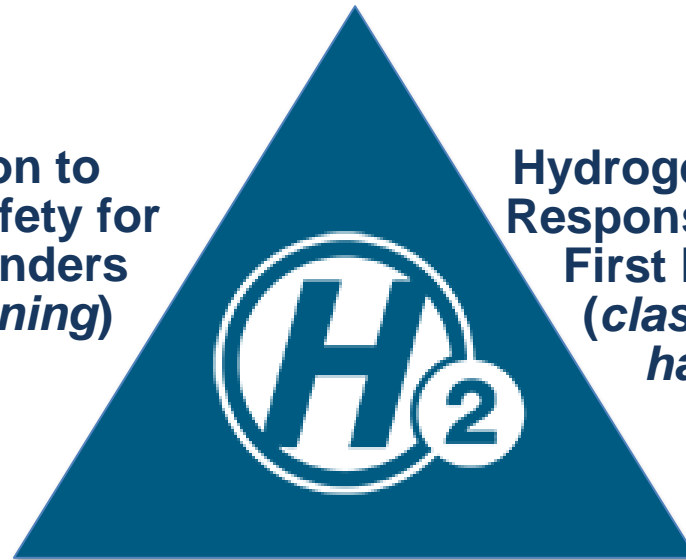
## Hydrogen Safety Training for First Responders

- Online awareness-level training
- Operations-level course including classroom and hands-on training
- National hydrogen emergency response education program (template)

# Integrating the approach to first responder training

**Introduction to  
Hydrogen Safety for  
First Responders**  
*(online training)*

**Hydrogen Emergency  
Response Training for  
First Responders**  
*(classroom and  
hands-on)*



**National Hydrogen  
Emergency Response  
Education Program**  
*(slide library)*

## **Long Term Goal**

Support the successful implementation of hydrogen and fuel cell technologies by providing technically accurate hydrogen safety and emergency response information to first responders

# Online awareness-level training


Address <http://www.ehammertraining.us/energy/hydrogen/controller.cfm>

## Introduction to Hydrogen Safety for First Responders

U.S. Department of Energy  
Hydrogen Program  
[www.hydrogen.energy.gov](http://www.hydrogen.energy.gov)

**COURSE MATERIALS** LIBRARY EXIT ▶

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



The Course Materials cover the following topics:

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

**Online course content**

You can view the topic modules in sequence or select them in random order using the top navigation bar.

A short quiz follows at the end of the course. User responses will be collected but will not be attributed to you as an individual.

[Begin the Course ▶](#)

<http://hydrogen.pnl.gov/FirstResponders/>

Internet

*"Did this during my lunch hour and really enjoyed it. Thank you for a pleasant learning experience."*

*"Very informative; we all need to see this."*

- 100 from hydrogen and emergency response community conduct broad review (Summer 2006)
- On-line training launched January 27, 2007
- 200-300 unique visits monthly; >30,000 total.

# Operations-level training combines classroom curriculum and live-fire exercises

- ▶ Classroom curriculum
  - Hydrogen and fuel cell basics
  - Hydrogen vehicles
  - Stationary facilities
  - Emergency response
  - Incident scenarios
- ▶ Demonstrations/hands-on exercise with FCEV prop
  - Demonstration of hydrogen flame characteristics
  - Student participation in rescue evolutions



*Multiple instructors for classroom training*



# Hydrogen burn prop demonstrations and Hands-on training



*Training reinforces need for first responders to utilize thermal imaging camera to see hydrogen flames.*



*A "rescue" at Sunnyvale (CA) Department of Public Safety*

# Relevant training delivered

"I feel more comfortable with the topic of hydrogen."

"Good course. It has taken away the mystery of a hydrogen FCV."

Agency	Location	Date	Trained
HAMMER Federal Training Center	Richland, WA	2009 - 2010	66
Rio Hondo Community College	Santa Fe Springs, CA	August 2010	103
Orange County Fire Authority	Irvine, CA	August 2010	92
Sunnyvale Department of Public Safety	Sunnyvale, CA	September 2010	110
San Joaquin Defense Logistics Agency	Stockton, CA	June 2011	41
Los Angeles City Fire Department	Los Angeles, CA	January 2012	128
Los Angeles County Fire Department	San Dimas, CA	March 2012	170
Honolulu Fire and Federal Fire-HI	Honolulu, HI	February 2013	155
HI County Fire and Volcanoes National Park	Hilo, HI	February 2013	135

"Very pertinent to our jobs. Answered any myths or questions about fire/hydrogen."

**total 1,000**





# ***What and Why – National Hydrogen and Fuel Cell Emergency Response Education Program***

***A properly trained first responder community is critical to the successful introduction of hydrogen fuel cell applications and their transformation in how we use energy.***

- ▶ Hydrogen and fuel cell-related first responder training utilizing a national emergency response education program as a consistent source of accurate information and current knowledge.
- ▶ A resource adaptable to the specific needs of first responders and presentation styles of training organizations and meant to complement extensive training programs already in place.
- ▶ The nationally-focused training template intended to serve as a resource and guide for the delivery of a variety of training regimens to various audiences.
- ▶ The template delineates this concept as L1-Overview, L2-Intermediate and L3-Detailed and suggests training materials accordingly.
- ▶ Feedback from presenters and audiences to the developers of the National Hydrogen and Fuel Cells Emergency Response Education Program will help ensure that the development of new and updated training content and techniques serves to continually enhance the value of this resource.

# Training template approach

## A slide library

FR Template

1. Introduction and Background +
2. Hydrogen and Fuel Cell Basics +
3. Hydrogen-Fueled Vehicles (light duty and transit) +
4. Stationary Facilities +
5. Managing Hydrogen-Related Emergencies +
6. Practical Exercises +



National Hydrogen Emergency  
Response Education Program

Collaborating with the



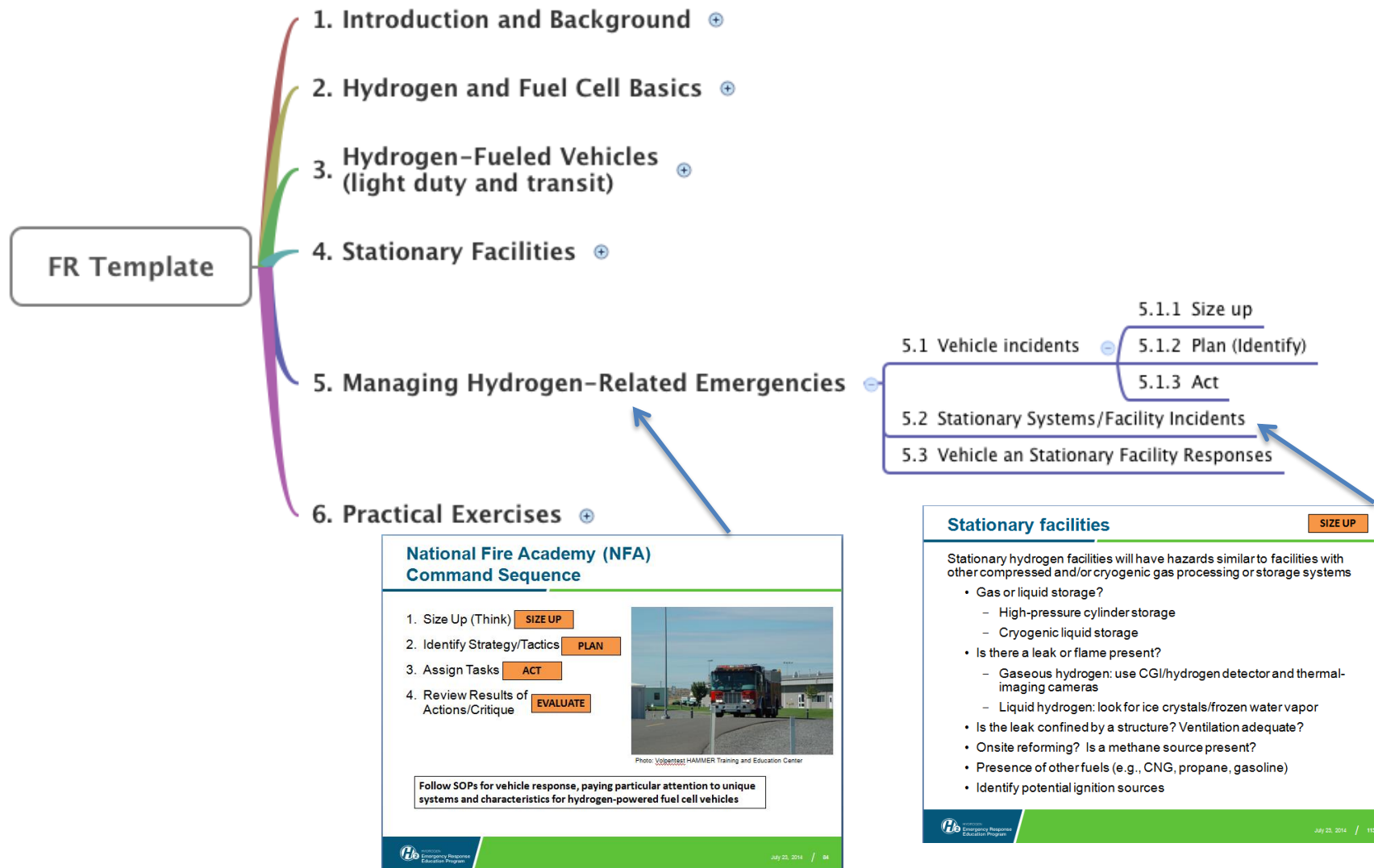
# Illustrating the use of the template

## First Responder Training Template

- Slide #1 National Hydrogen Emergency Response Education Program
- Slide #2 What and Why

	Level 1 Overview	Level 2 Intermediate	Level 3 Detailed
<b>1. Introduction and Background (Slide #3)</b>			
• Slide #4 Fuel cells overview and benefits	✓	✓	✓
• Slide #5 Fuel cells – Where are we today?		✓	✓
• Slide #6 Diverse fuel cell transportation applications		✓	✓
<b>2. Hydrogen and Fuel Cell Basics (Slide #7)</b>			
2.1 Hydrogen – Where does it come from and how do we use it today?			
2.2 Properties of hydrogen and its safe use			

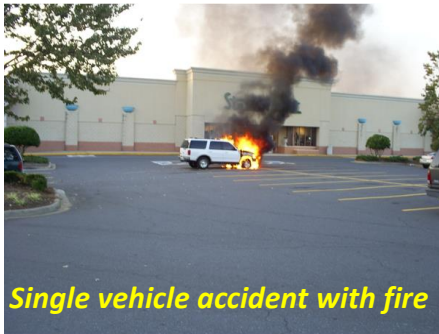
# Managing hydrogen-related emergencies



# Accident scenarios provided for group discussion

## FR Template

1. Introduction and Background +
2. Hydrogen and Fuel Cell Basics +
3. Hydrogen-Fueled Vehicles (light duty and transit) +
4. Stationary Facilities +
5. Managing Hydrogen-Related Emergencies +
6. Practical Exercises +



*Single vehicle accident with fire*



*Multiple vehicle accident*



*Unintended hydrogen release in an enclosure*



# A Vision – First Responder Training

*Hydrogen and fuel cell-related first responder training is delivered locally to serve missions to protect life and preserve property, utilizing a national emergency response education program as a consistent source of accurate information and current knowledge.*

*A training template approach is utilized to achieve this vision by facilitating*

- ▶ *delivery of a variety of training regimens to various audiences,*
- ▶ *development of new and updated training content and techniques and*
- ▶ *encouragement of collaborations among various stakeholders to achieve purposeful results.*

# Identifying new tools needed to remove barriers to commercialization

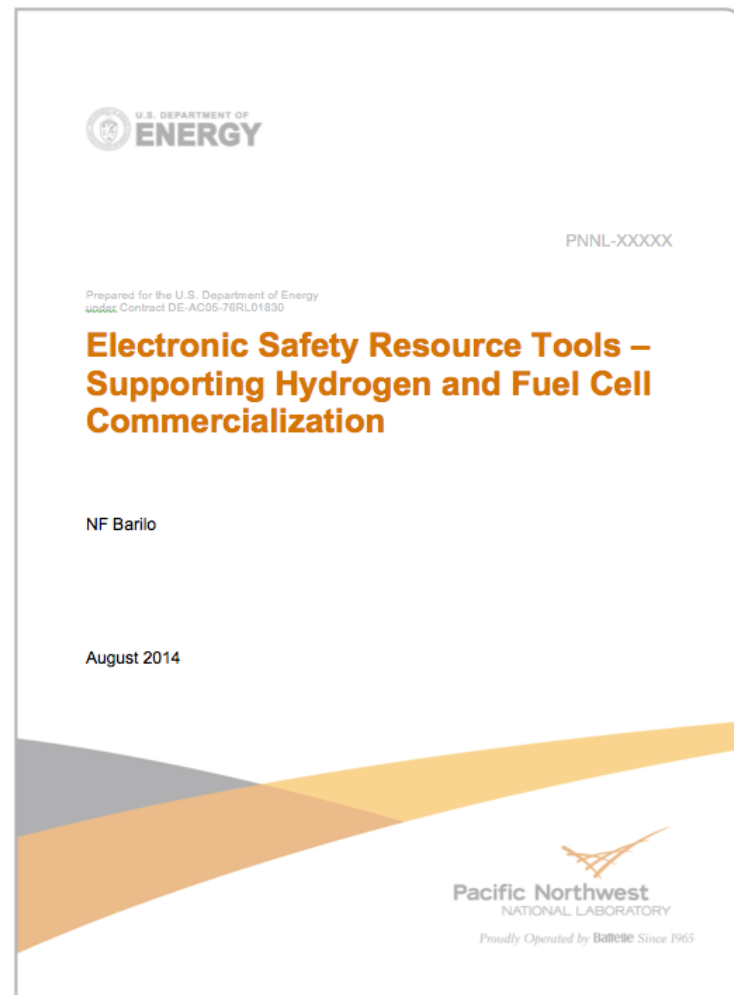
## ► Highest priority new tools

1. Hydrogen safety portal
2. Codes and standards guide
3. **Scenario-based training for first responders**
4. **Peer networking tools**
5. Training for inspectors

*to meet the needs of the*

## ► Highest priority user groups

1. AHJs
2. First responders
3. O&M personnel
4. Public
5. Project proponents
6. Researchers, scientists and engineers
7. Investors
8. Insurers and risk managers



# Implementation of new tools

- ▶ Scenario-based training for first responders
  - Address limitations associated with classroom course and hands-on, scenario-based training for both classroom and remote participants
  - Utilize “a 3-D simulation platform aimed at teaching, training and qualifying response units for increased preparedness...”
  - Allow for a broader set of fuel cell application-based scenarios to meet specific training needs
- ▶ Peer networking
  - Social movement tools to establish connection and discussions among peers within various user groups, e.g., AHJs and inspectors with potential to reduce delays in project approvals
  - Is there value here for the first responder community?

# *Is this the intersect of training and social media?*



Source: Nina Kujala, Fingrid Oyj

# Hydrogen Tools

## *A Transformative Step Towards Hydrogen Adoption*

### CENTRALIZED LOCATION

organizes current H<sub>2</sub> resources in one robust location—including **more than 20** existing tools, with plans for adding future content

### FOCUSED CONTENT

tailored to the specialized needs of H<sub>2</sub> user groups

### CUSTOMIZABLE INTERFACE

allows content to display based on the H<sub>2</sub> user's role or interests

### RESPONSIVE DESIGN

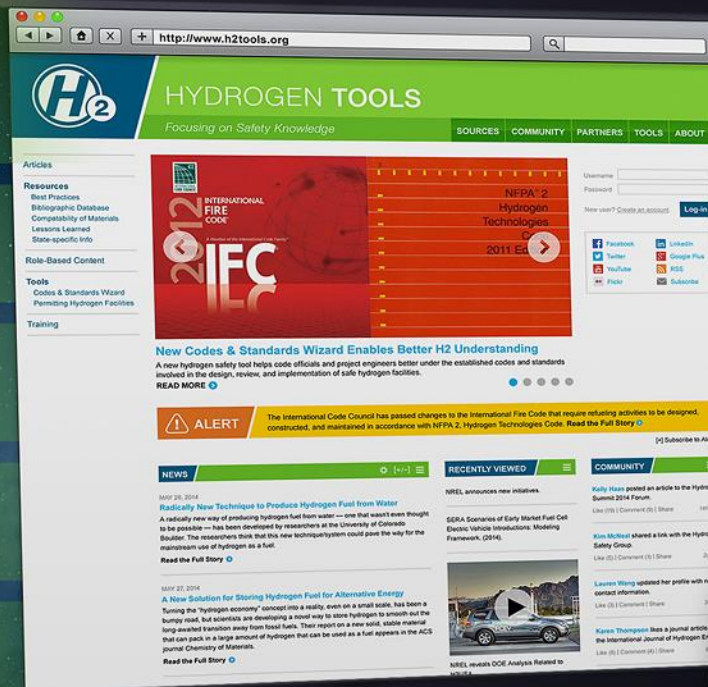
enables H<sub>2</sub> safety work across both desktop and mobile devices

### TRUSTED COMMUNITIES

fostered through social networking around H<sub>2</sub> subject matter expertise

### EXPANDABLE FORMAT

built with frequently requested future feature sets in mind



+ Mobile Friendly



► **Credible** and **reliable** safety information from a **trustworthy** source



# Concluding thoughts

- ▶ To remain vital and useful, training resources require a concerted effort beyond just general maintenance. The content must be current, relevant to the community being served and valuable to the individual user.
- ▶ Collaboration will continue to be an essential element of our future work in first responder training.

# A sampling of publications and presentations

- ▶ Fassbender, L.L., Akers, B.M., and Cooper, C., “Introduction to Hydrogen Safety for First Responders,” Firehouse®, August 2007, pp 158-159.
- ▶ Weiner, S.C., “Hydrogen Safety Training for First Responders,” Istituto Superiore Antincendi (Fire Prevention Institute), Rome, Italy, October 5, 2010.
- ▶ Elmore, M.R., Fassbender, L.L., Hamilton, J.J. and Weiner, S.C., “Hydrogen Emergency Response Training for First Responders,” PNNL-SA-79009/82560, International Conference on Hydrogen Safety, San Francisco, CA, September 12-14, 2011.
- ▶ Weiner, S.C., Fassbender, L.L., Blake, C., Aceves, S., Somerday, B.P. and Ruiz, A., “Web-Based Resources Enhance Hydrogen Safety Knowledge,” PNNL-SA-82812, International Journal of Hydrogen Energy, Volume 38, Issue 18, June 2013, pp 7583-7593.
- ▶ Hamilton, J.J., “Development of a Hydrogen and Fuel Cell Vehicle Emergency Response National Template,” International Conference on Hydrogen Safety, Brussels, Belgium, September 10, 2013.
- ▶ Elmore, M.R., “Hydrogen and Fuel Cell Vehicles: Educating Emergency Responders,” NFPA Conference & Expo, Las Vegas, NV, June 9-12, 2014.

# Thank you

- ▶ The U.S. Department of Energy's Fuel Cell Technologies Office for their support
- ▶ All those who contributed in so many ways over many years to the successes in our first responder training work
- ▶ The FCH-JU, ENSOSP and the HyResponse project team for recognizing the need for and value of first responder training and various collaborations to support the next phase of hydrogen fuel cell commercialization

# Contacts for more information

- ▶ Nick Barilo  
Hydrogen safety program manager  
001 509-371-7894  
[nick.barilo@pnnl.gov](mailto:nick.barilo@pnnl.gov)
- ▶ Steven C. Weiner  
Hydrogen Safety Panel  
[sc.weiner@pnnl.gov](mailto:sc.weiner@pnnl.gov)