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Hydrogen Safety Panel
Evaluation of Hydrogen Facilities

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Annual Merit Review, Washington, DC
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h2053

Overview

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Hydrogen Safety Panel (HSP) Evaluation of Hydrogen Facilities

Project Timeline

- Project start date: April 2018
- Project end date: January 2020[1]

Budget

- Total CRADA funding: $145K
  - Total DOE share: $130K
  - Total match (CCAT) share: $15K
- Funding spent as of January 2019: $38K

Barriers Addressed[2]

A. Safety data and information — limited access and availability

C. Safety is not always treated as a continuous process

D. Lack of hydrogen knowledge by authorities having jurisdiction (AHJs)

Partners

- Connecticut Center for Advanced Technologies (CCAT)

[1] Project continuation and direction determined annually by DOE.

[2] Technical Plan – Hydrogen Safety, Codes and Standards, Section 3.7, Multi-Year Research, Development and Demonstration Plan, 2015, pp. 21-22 (updated June 2015), https://www.energy.gov/sites/prod/files/2015/06/f23/fcto_myrdd_safety_codes.pdf.

Hydrogen Safety Resources

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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

HYDROGEN
Tools

- Hydrogen Lessons Learned
- Hydrogen Best Practices
- Hydrogen Tools web portal (http://h2tools.org)

HYDROGEN
Emergency Response Training Resources

- Online awareness training
- Operations-level classroom/hands-on training
- National hydrogen and fuel cell emergency response training resource

PNNL Hydrogen Safety Program Timeline

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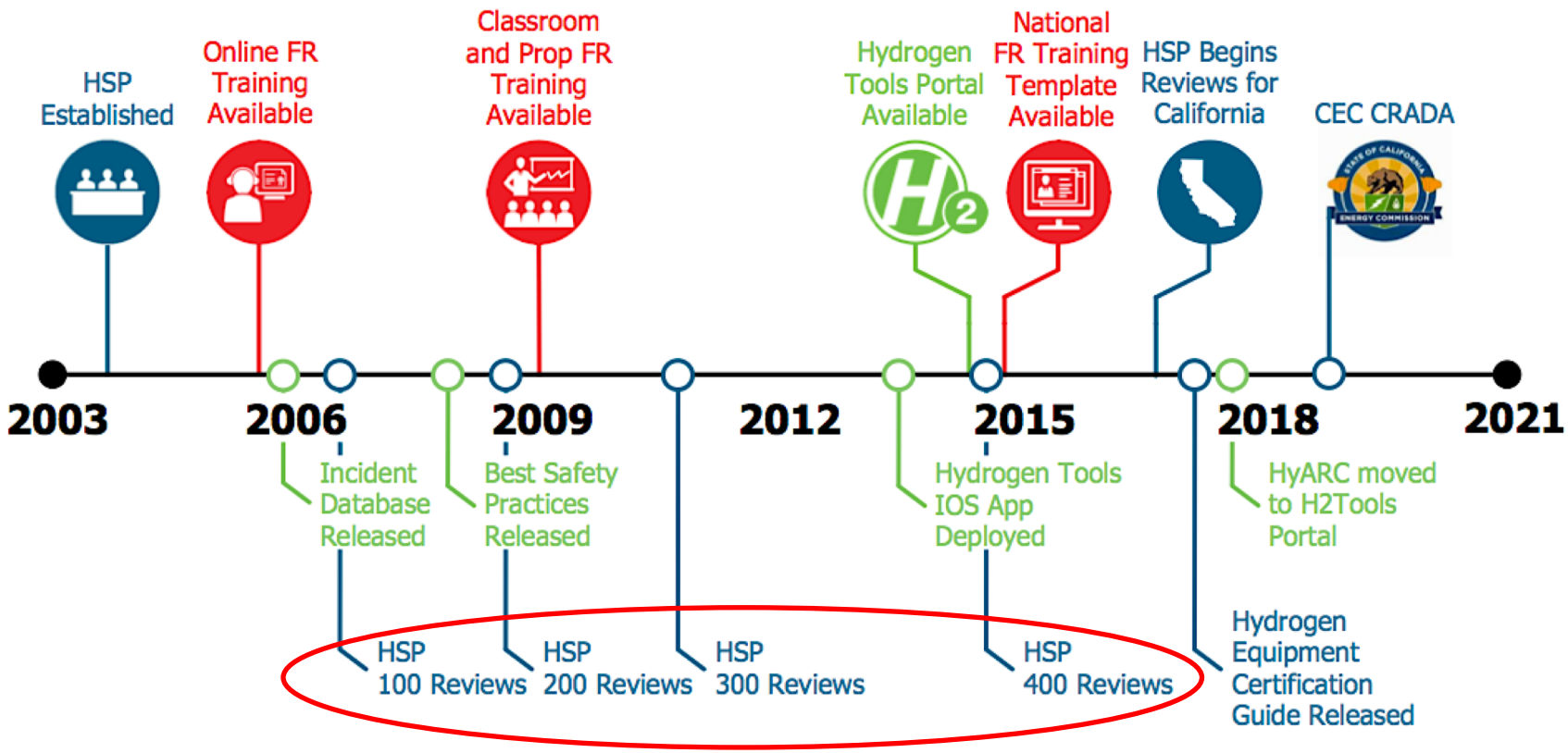
- Hydrogen Safety Panel
- Safety Knowledge Tools
- First Responder Training



The HSP has extensive safety review experience

Hydrogen Safety Panel

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The HSP promotes safe operation, handling, and use of hydrogen

- Formed in 2003
- 15 members with **400+ years** combined experience
- **497 hydrogen safety reviews completed** – hydrogen fueling, auxiliary power, backup power, combined heat and power, portable power, and lab R&D
- White papers, reports, and guides
- Provides support on the application of hydrogen codes and standards
- **H_2 safety knowledge shared through the H_2 Tools Portal** (h2tools.org)

Some of the fire officials and hydrogen experts that comprise the Hydrogen Safety Panel (24th meeting, 2017, Cambridge, MA)

Hydrogen Safety Panel Membership

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The HSP is a multidisciplinary team of engineers, code officials, safety professionals, equipment providers, and testing and certification experts. The Panel provides guidance for hydrogen projects and facilities, including design and process safety reviews, support/review of risk analyses, onsite safety presentations, and training.

Name	Affiliation
Nick Barilo, Manager	Pacific Northwest National Laboratory
Richard Kallman, Chair	City of Santa Fe Springs Fire Dept.
Ken Boyce	UL
David Farese	Air Products and Chemicals
Donald Frikken	Becht Engineering
Livio Gambone	Nikola Motors
Aaron Harris	Air Liquide
Brian Ladds	Calgary Fire Department
Chris LaFleur	Sandia National Laboratories
Miguel Maes	NASA-JSC White Sands Test Facility
Steve Mathison	Honda Motor Company
Larry Moulthrop	Proton OnSite (retired)
Andrei Tchouvelev	A.V. Tchouvelev & Associates Inc.
Tom Witte	Witte Engineered Gases
Robert Zalosh	Firexplo

Relevance

Activities that can benefit from HSP involvement

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Early Concept Support

Pre-Project

- **Safety planning webinars**
- Pre-project outreach to stakeholders
- ***H_2 safety training and orientation for code officials**
- Project team safety planning consultations

Early Design

- Safety plans reviews
- ***Review project/ facility early designs**
- Participate in risk analyses development
- **Review risk analyses**
- *Address AHJ safety questions

Early Operation

- Evaluate safety features of completed facilities
- **Onsite safety evaluations**
- Provide first responder H_2 safety training

Program Support

- **Identify safety gaps**
- Develop industry guides
- ***Expert support for incident fact-finding and investigations**
- Bolster stakeholder and public confidence

Successful Project Implementation

* Support for AHJ and code officials can bridge the gap for inexperienced staff, facilitate faster approvals, foster greater confidence in project safety, and provide more technically justified safety features or alternate means and methods.

Relevance

Highlighting the impact of HSP past activities

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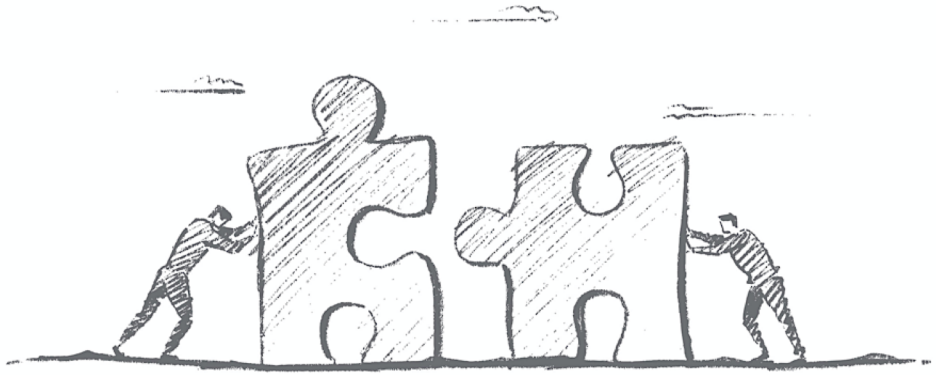
- Serves as a non-regulatory, objective, and neutral resource
- Sees the "big picture"
  - Shares learnings
  - Identifies gaps
- Can help reduce costs
  - Over-engineering resulting in unnecessary features
  - Delayed approvals
  - Missed safety considerations/features
- A group with diverse experience can:
  - Respond with a balanced solution to questions, problems, and issues
  - Aid in avoiding repeating costly mistakes among disparate project proponents
  - Help project proponents avoid industry-impacting incidents
  - Help establish stakeholder and public confidence



Approach

This project promotes the HSP as a resource to assist stakeholders with the safe implementation of hydrogen fuel cell technologies. The activity focuses on Northeast states with these objectives:

- Raising awareness of the HSP among state/local officials and project developers
- Establishing working relationships with key state and local organizations to enable seamless incident response and development of safety lessons learned
- Identifying types of projects that would benefit from HSP involvement
- Identifying methods to facilitate outside organizations paying for HSP

<u>Teaming arrangement:</u>

- PNNL/HSP training expertise
- CCAT Northeast network contacts

Location of Stakeholder Meetings in September/October 2018

Approach – Project Goals

The goal of this work is to use the PNNL HSP in support of H2@Scale projects in the Northeast U.S. To achieve this goal, the activities may include:

- Presenting safety learnings and best practices to project stakeholders
- Providing applicants with consultation on safety planning (as necessary)
- Reviewing safety plans and providing feedback to the Northeast U.S. hydrogen project stakeholders
- Performing early project design reviews to identify safety concerns and gaps
- Participating in fact-finding activities associated with hydrogen incidents and near-misses
- Performing site visits to facilities completed as a part of this project (subject to need)
- Aiding code officials and AHJs with the application of hydrogen safety practices
- Identifying project learnings/best safety practices that can be disseminated

Accomplishments and Progress

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Stakeholder meetings to date:

- New Haven, CT
- Westerly, RI
- New Brunswick, NJ
- Amherst, MA
- Albany, NY
- Stow, MA
- Cambridge, MA

Accomplished to date:

- Informed previously unaware code officials, stakeholders, and project proponent attendees about HSP resources and activities
- Discussions are in process with project proponents interested in using the HSP for safety reviews
- Engaging new stakeholder groups from small aircraft/unmanned aerial vehicle (UAV) sector
- Session videos captured and produced

Accomplishments and Progress

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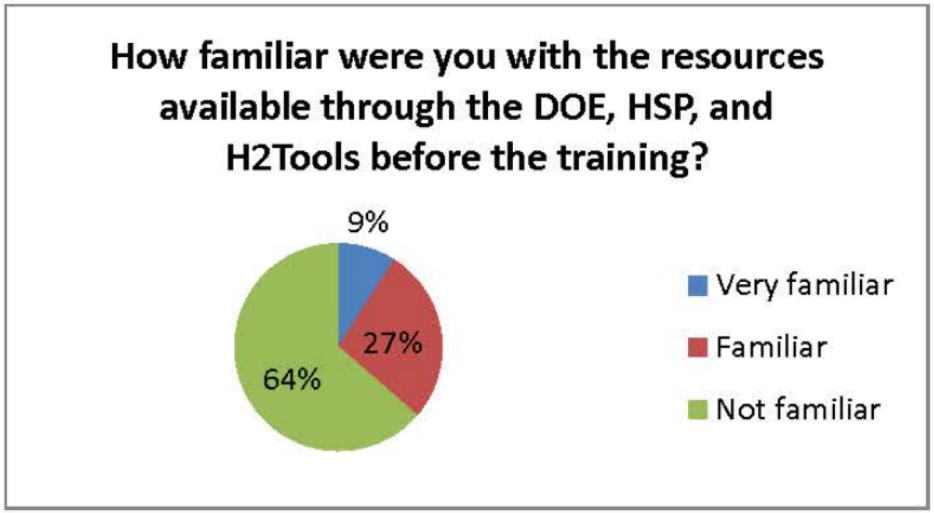
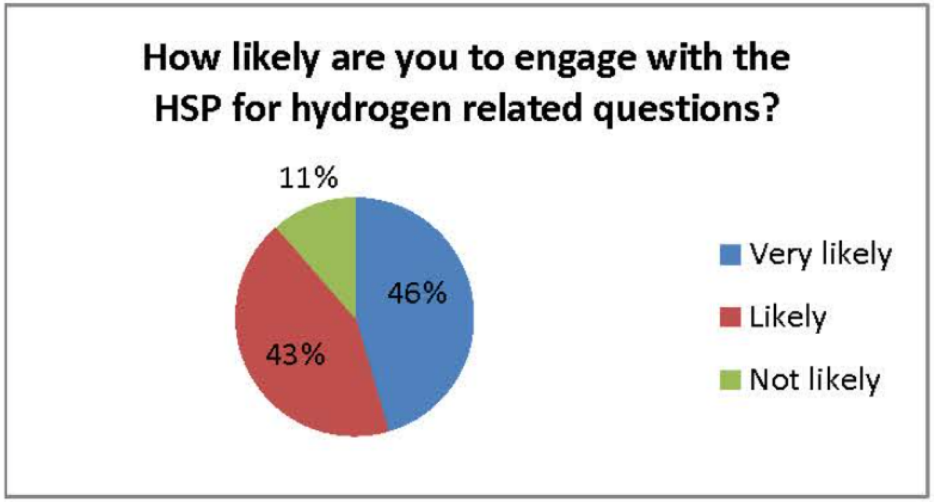
To build attendance and magnify impact, most stakeholder meetings were combined with hydrogen safety training

Training was well received and many of the training attendees stayed for stakeholder meetings

Post-event polls show:

- **64% of respondents learned of hydrogen safety resources for the first time**
- **89% of respondents are likely to engage with HSP**





Future Work

- More stakeholder meetings to be scheduled for late spring/early summer:
  - In and/or near New York City
  - New Jersey
  - Delaware
- HSP to perform safety reviews for project proponents and/or government agencies identified at the September/October 2018 and summer 2019 stakeholder meetings
- A final project report to be assembled in early CY20

Location of Stakeholder Meetings In Summer 2019

Summary

- The approach and meetings were extremely beneficial for connecting with audiences that may not have had exposure to the HSP or its capabilities
- The meetings were well received by attendees and helped broaden their perspective on hydrogen and fuel cell technologies and available hydrogen safety resources
- The success of joint educational session and stakeholder meeting is a good format for future activities
- Collaboration with CCAT was highly productive and jeincreased the reach of these activities

Connecticut Center for Advanced Technology, Inc.

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Thank You!

- U.S. Department of Energy
  - Fuel Cell Technologies Office (Sunita Satyapal, Director, and Laura Hill, Safety, Codes, and Standards Manager)
- Connecticut Center for Advanced Technologies
  - Paul Aresta
  - Joel Rhinebold
- All of my colleagues at Pacific Northwest National Laboratory, the Hydrogen Safety Panel, and other collaborators
- AMR reviewers – your comments and perspectives are important to helping us identify areas for improvement and be more impactful