Hydrogen Safety Panel

presented by

Steven C. Weiner

for the

Hydrogen Program Annual Merit Review and Peer Evaluation Meeting

June 9, 2010

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Project SCS008

PNNL-SA-72046

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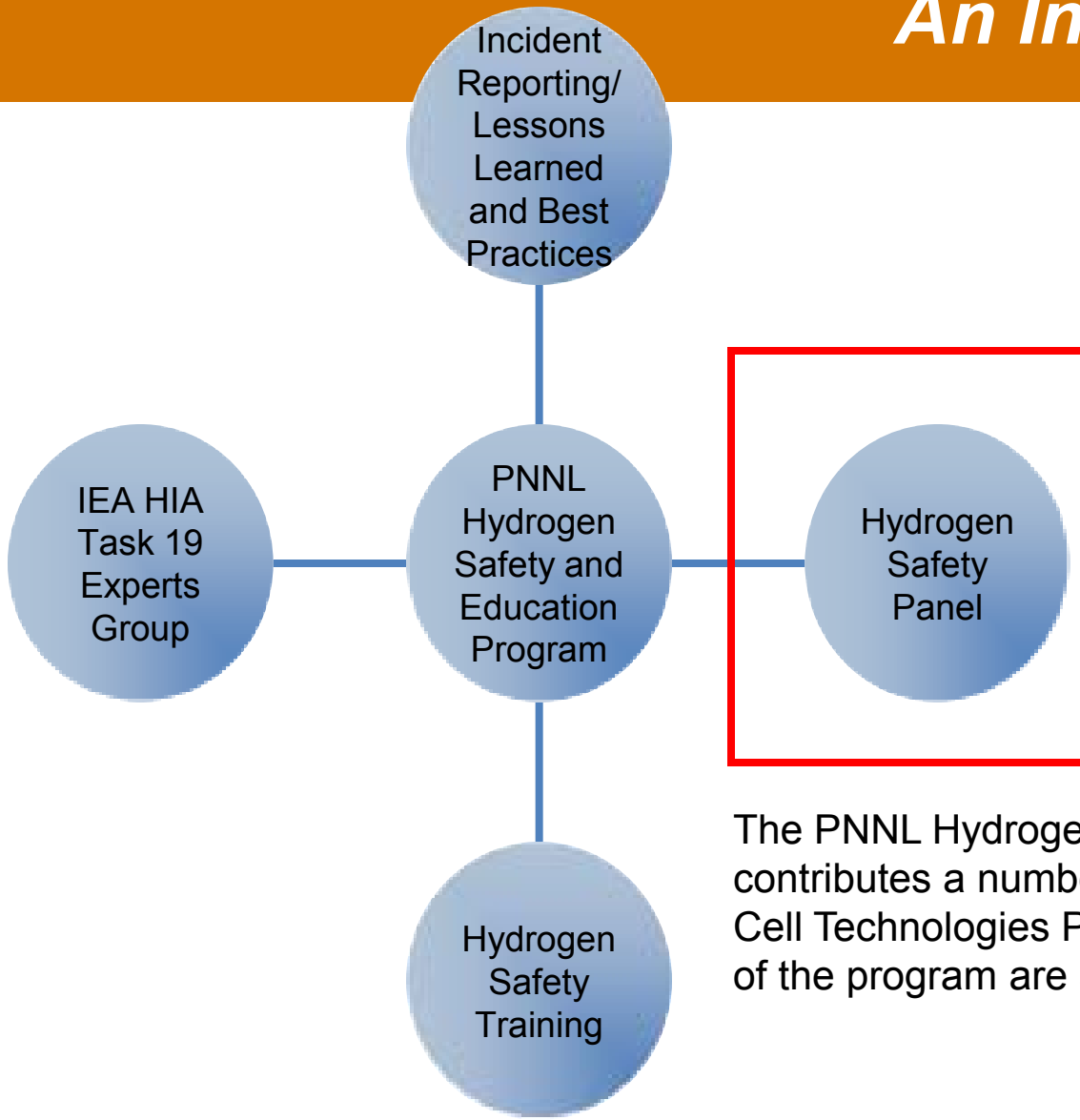
PNNL Hydrogen Safety and Education Program
An Integrated Approach



The PNNL Hydrogen Safety and Education Program contributes a number of important activities to the Fuel Cell Technologies Program. The current main elements of the program are shown here.

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Overview

Timeline

- First Panel meeting: December 11, 2003
- Continuing

Budget

- FY09 = $850K
- FY10 = $750K

Hydrogen Safety Panel at NREL's Wind Technology Center

Barriers addressed[1]

E. Variation in standard practice of safety assessments for components and energy systems

F. Safety is not always treated as a continuing process

G. Expense of data collection and maintenance

Collaborations

- Energetics Incorporated
- Panel member organizations
- IEA Hydrogen Implementing Agreement Task 19 (Hydrogen Safety)

[1]Hydrogen, Fuel Cells & Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan, October 2007.

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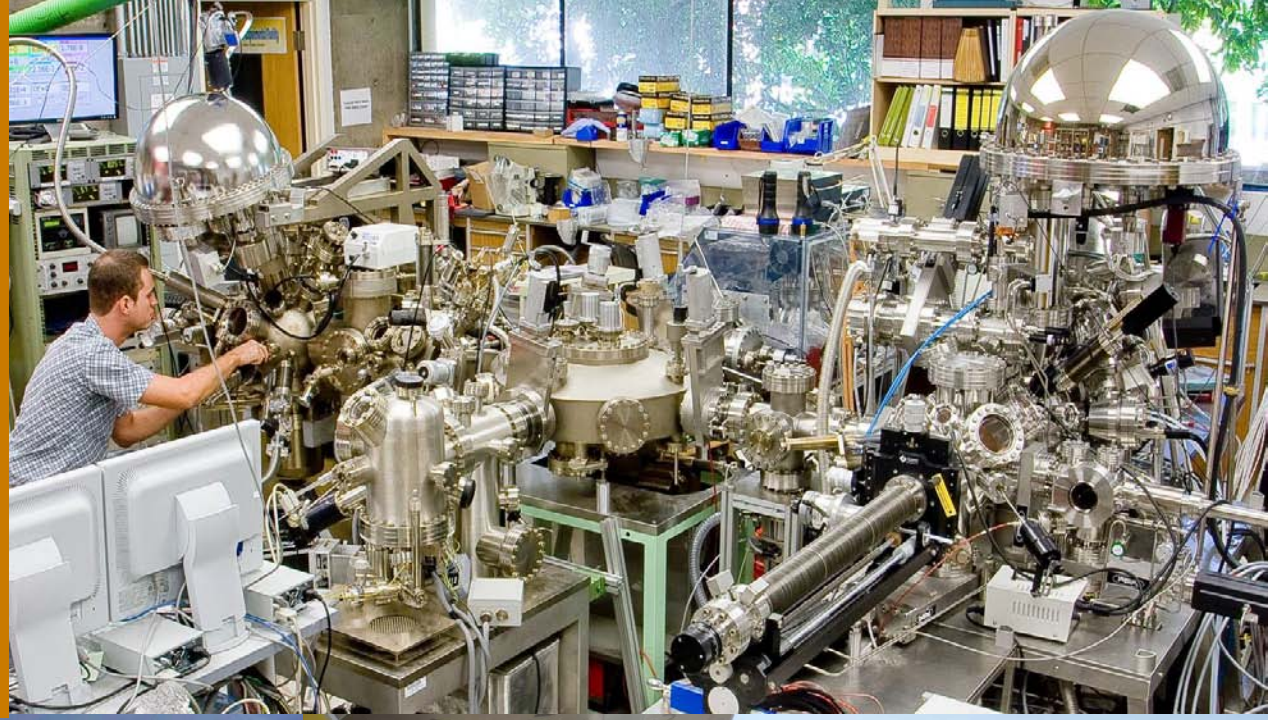
Hydrogen Safety Panel

Richard Kallman, Chair	City of Santa Fe Springs, CA
Steven Weiner, Program Manager and Panel Coordinator	Pacific Northwest National Laboratory
Addison Bain	NASA (ret)
Harold Beeson	NASA White Sands Test Facility
David Farese	Air Products and Chemicals
Bill Fort	Shell Global Solutions (ret)
Don Frikken	Becht Engineering
Michael Pero	Hydrogen Safety, LLC
Glenn Scheffler	GWS Solutions of Tolland LLC
Andrew Sherman	Powdermet Inc.
Ian Sutherland	General Motors
Robert Zalosh	Firexplo
Nick Barilo, Technical Support	Pacific Northwest National Laboratory
Ed Skolnik, Technical Support	Energetics Inc.

Objectives

- Provide expertise and guidance to DOE and assist with identifying safety-related technical data gaps, best practices and lessons learned.
- Help DOE integrate safety planning into funded projects to ensure that all projects address and incorporate hydrogen and related safety practices.

From Laboratory to Demonstration to Deployment



What are we trying to achieve?

- DOE and the Hydrogen Safety Panel are working to ensure safe operation in the handling and use of hydrogen and hydrogen systems for all DOE projects. That vision will be achieved when
  - Project teams give sufficient priority to safety in their work.
  - Project teams are aware of relevant issues and best practices that affect safe operation and handling of hydrogen and related systems.
  - Safety-related gaps are identified and addressed.

Hallmarks of Our Approach

- Engage Panel members, OEMs, energy companies, international partners, first responders and other stakeholders in all aspects of our hydrogen safety program
- Focus interactions with project teams on learning, knowledge sharing and encouragement of thorough, continuous and priority attention to safety

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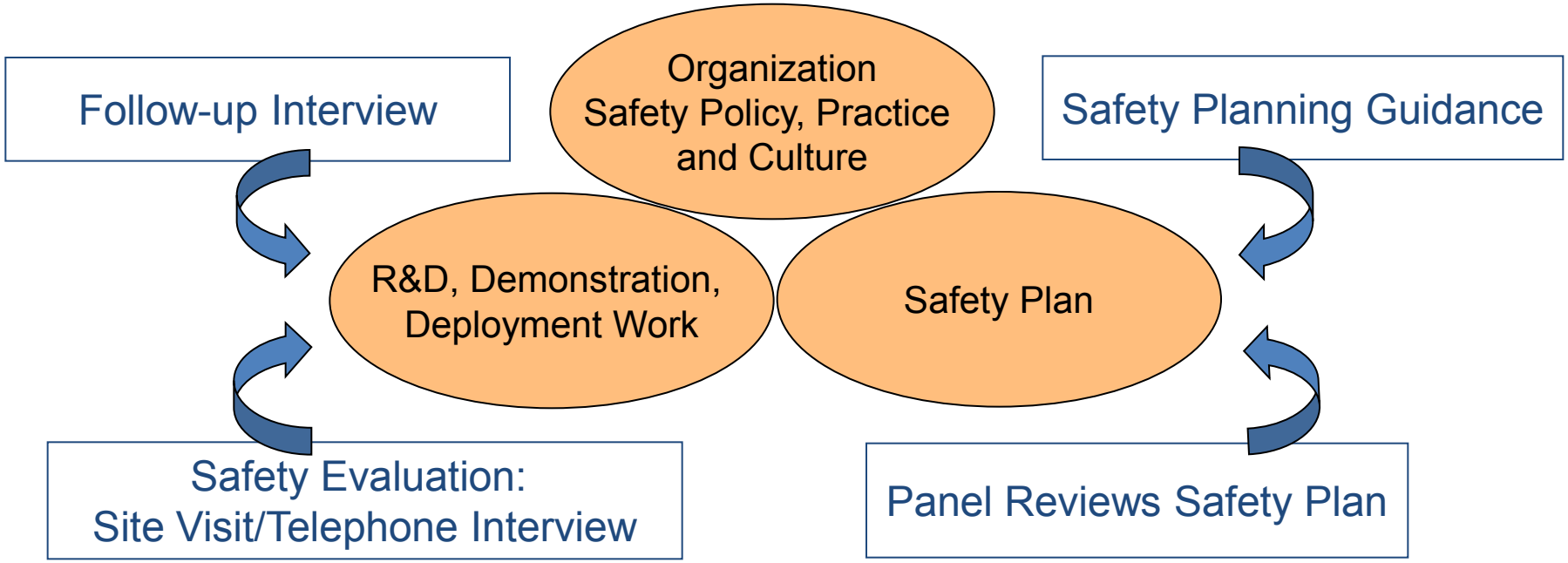
Hydrogen Safety Panel Engaging the Project Team

The Project



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Hydrogen Safety Panel Meetings Enhance Other Engagements

- Conducted two meetings of the Hydrogen Safety Panel
  - 12th Meeting, Powertech Labs, Vancouver/Surrey, BC, Canada, June 23-25, 2009
  - 13th Meeting, Energetics, Washington, DC, December 8-9, 2009
  - 14th Meeting (scheduled for June 22-24, 2010), Savannah River National Laboratory, Aiken, SC
    - Center for Hydrogen Research: Hydrogen Storage Engineering Center of Excellence
    - Visit materials handling facilities using hydogen fuel cell lift trucks

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Hydrogen Safety Panel By the Numbers…

- 235 safety plans reviewed
- 39 safety reviews conducted
- 13 Panel meetings held
- 8 follow-up interviews conducted
- 6 “good example” safety plans provided
- 5 “white paper” recommendations submitted
- 2 incident investigations completed

Technical Accomplishments, Progress and Results – Safety Planning

- Safety planning work expanded with project interaction
  - Reviewed 56 safety plans since January 2009.
  - Six project safety plans currently provided as “good examples” and most recently added:
    - Colorado School of Mines
  - Revised and updated “Safety Planning Guidance for Hydrogen Projects” to serve as a resource for project teams.

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Technical Accomplishments, Progress and Results – Project Safety Reviews

- Safety reviews are focused on engagement, learning and discussion with project teams
  - 19 safety reviews conducted/reported since January 2009.
  - Site visits result in a substantial number of recommendations to DOE and the project teams: 41 recommendations in six reports issued since January 2009.
  - Hydrogen Safety Panel conducted teleconference follow-up interviews with project teams to discuss report recommendations.
    - Identify actions taken and conclusions reached, measure impact and validate approach

"Not only did it reinforce the importance of safety, we benefited from having experts available for discussions."

- Florida Solar Energy Center

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Measuring Outcomes from Safety Reviews Categorizing Recommendations and Actions…

…covering eight project safety reviews

Category	Recommedations Implemented	Partial or In Progress	No Action	Total Recommendations
Safety Vulnerability/ Mitigation Analysis	13	3	4	20
System/Facility Design Modifications	4	4	1	9
Equipment/Hardware Installation and O&M	5	4	0	9
Safety Documentation	4	4	0	8
Training	1	2	0	3
Housekeeping	4	2	0	6
Emergency Response	6	2	2	10
Total	37	21	7	65

Secondary Protection for 70MPa Fueling White Paper from the Hydrogen Safety Panel

- The Goal
  - Ensure that a vehicle equipped with a lower service pressure fuel tank is never filled from a 70 MPa fueling source.
- The Problem
  - Many current hydrogen vehicles with 35 MPa storage systems; larger fleet of CNG vehicles that are also equipped with lower service pressure fuel tanks.
  - There are credible scenarios that could lead to the catastrophic failure of the tank.
- The Recommendations
  - Perform an independent risk analysis of a 70 MPa dispenser filling a lower pressure vehicle tank and develop approaches for prevention and mitigation to meet an acceptable level of safety.
  - Communicate the potential risk to responsible parties and strongly encourage those parties to add a secondary layer of protection to the existing system of mechanically non-interchangeable nozzles/receptacles.

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Future Work

- Remainder of FY2010
  - American Recovery and Reinvestment Act (ARRA) fuel cell deployments
    - Review safety plans and conduct safety review site visits

Priority

  - Continue to review all project safety plans and conduct safety review site visits for Storage projects as planned
  - Propose FY2011 Annual Operating Plan (AOP) to DOE
    - Consider AMR feedback from DOE and reviewers
- FY2011
  - Complete ARRA safety review site visits and final report summarizing findings and conclusions

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Thank you…

- U.S. Department of Energy
  - Fuel Cell Technologies Program (Richard W. Farmer, Acting Program Manager; Antonio Ruiz, Safety Codes and Standards Team Leader)
- Colleagues at Pacific Northwest National Laboratory, the Hydrogen Safety Panel and other collaborators
- You, the audience

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