Hydrogen Safety Review Panel

Safety Planning, Practices and Lessons Learned

Hydrogen Safety Review Panel

Don Frikken, Chair – Becht Engineering

Addison Bain – NASA

Harold Beeson – NASA White Sands

Richard Kallman – City of Santa Fe Springs, CA

Michael Pero – Hydrogen Safety, LLC

Harold Phillippi – ExxonMobil Research and Engineering Co.

Jesse Schneider – DaimlerChrysler

Andrew Sherman – Powdermet Inc.

R. Rhoads Stephenson – Motor Vehicle Fire Research Institute

Bob Zalosh – Worcester Polytechnic Institute

Steven C. Weiner, Coordinator* – Pacific Northwest National Laboratory

Edward Skolnik, Technical Evaluator – Energetics, Inc.

**For further information, contact Panel Coordinator - sc.weiner@pnl.gov*

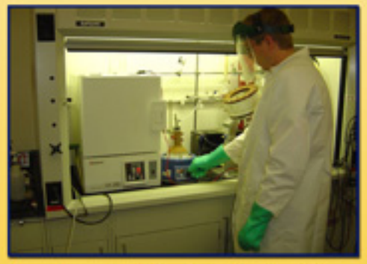
Hydrogen Safety Program Goal

Develop and implement the practices and procedures that will ensure safety in the operation, handling, and use of hydrogen and hydrogen systems for all U.S. Department of Energy (DOE) projects; utilize these practices and lessons learned to promote the safe use of hydrogen throughout the emerging hydrogen economy.

The panel serves to

- provide expertise and guidance to DOE and assist with identifying areas of additional research, best practices and lessons learned
- help DOE integrate safety planning into funded projects to ensure that all projects address and incorporate hydrogen safety requirements.

The National Renewable Energy Laboratory is examining the integration of renewable energy with electrolysis to produce hydrogen. The panel conducted a safety review of NREL's development work.



The use of personal protective equipment is an important aspect of laboratory safety. The panel has discussed numerous laboratory safety issues with project teams.

They accomplish their work by

- discussing best practices and new insights that bear on safety with project teams
- addressing project-specific safety issues
- identifying project-specific findings that can have a broader benefit in the DOE program.

Through engaged discussions, guidance and recommendations the panel conducts and evaluates

- safety plan reviews
- telephone interviews
- safety questionnaires
- project site visits.

DTE Energy and their partners demonstrate an "end-to-end" hydrogen energy system in Southfield, MI. The panel captured lessons learned from the project during a safety review meeting.

Safety Practices and Lessons Learned

- **Safety Plans** – "Living" plans require the comprehensive identification and analysis of safety vulnerabilities, effective measures to mitigate risks and ongoing communications to enhance and implement safety practices and lessons learned.
- **Hydrogen Storage/Handling Facilities** – The design and siting of hydrogen systems present several options. The safety vulnerability analysis for handling, moving and distributing hydrogen should include the likelihood that increasing quantities of hydrogen will be required for future work in a given facility/location.
- **Equipment Maintenance and Sensor Calibration** – Written procedures and logs for equipment maintenance and calibration of safety-related sensors serve a similar functionality as standard procedures for experiments and operations. Procedures should follow manufacturer recommendations or other accepted standards.
- **Management of Change** – Any proposed change to materials, technology, equipment, procedures or facility operation should be reviewed for its effect on the analysis of safety vulnerabilities. This principle applies to hazardous work performed at the frequently changing laboratory scale.
- **Asphyxiating Gases** – Nitrogen asphyxiation incidents occur in a variety of facilities including industrial plants, laboratories and medical facilities. The use of enclosed spaces, such as laboratories or glove boxes, requires the assessment of the quantity, storage and flow rate of asphyxiating gases, the adequacy of ventilation and the need for oxygen depletion sensors.
- **Hydrides and Other Hydrogen Storage Materials** – Small quantities of hydrogen-containing materials, which are not well characterized, should be handled with procedures that assume a "worst case" for that class of materials, intermediates or precursors. To ensure integrity, hazard analysis might include calculating the maximum volume of hydrogen that could evolve from an otherwise sealed container.
- **Safety Event Reporting** – A reporting system delivers valuable lessons learned to participants in the DOE Hydrogen Program. This system requires information sharing, degrees of confidentiality and a commitment to create higher learning value from incidents and near-misses.