
VII.0 Safety, Codes & Standards Sub-Program Overview

Introduction

The Safety, Codes & Standards sub-program assesses current safety practices and the status of technical standards development efforts, both nationally and internationally. It develops and implements the practices and procedures that will ensure safety in the operation, handling and use of hydrogen and hydrogen systems for all DOE-funded Hydrogen Program projects. It also facilitates the creation and adoption of model building codes and equipment standards for hydrogen systems in commercial, residential, portable and transportation applications. Development of codes and standards also requires coordination of activities across government agencies (e.g., Department of Transportation and state government agencies), associations, corporate stakeholders, international stakeholders, and standards and code development organizations.

The safety activity involves a large degree of external stakeholder input. Expertise is gathered from hydrogen manufacturers, the energy industry, the insurance industry, fire protection, academia, aerospace, and others to provide the widest range of perspectives on safety possible. Input is obtained through involvement in a variety of activities, as detailed under the Technology Status section.

Communication is also a principal emphasis for maximizing the impact of all safety activities. All of the data and information obtained (of a non-confidential nature) through the safety activity are made widely available through public presentations and the release of an online Best Practices Manual scheduled for 2008. Safety information materials aiming to enhance the knowledge of emergency responders and local authorities having jurisdiction are made available through various media to the greatest number of recipients possible. In addition, all planning efforts supporting future activities are conducted through open workshops to ensure the engagement of interested stakeholders.

Goals

- Develop and implement the practices and procedures that will ensure safety in the operation, handling and use of hydrogen and hydrogen systems for all DOE projects and utilize these practices and lessons learned to promote the safe use of hydrogen.
- Perform underlying research to enable codes and standards to be developed for the safe use of hydrogen in all applications. Facilitate the development and harmonization of international codes and standards.

Objectives

- By 2008, develop a comprehensive safety plan in collaboration with industry that establishes Program safety policies and guidelines. DOE will utilize the Hydrogen Safety Panel's expertise and assistance in conducting safety evaluations and identifying areas of additional research.
- By 2008, publish a Best Practices for Hydrogen Safety Manual. The manual will be a "living" document that will provide guidance for ensuring safety in DOE hydrogen projects, while serving as a model for all hydrogen projects and applications.
- By 2012, develop hydrogen leak detection technologies such as sensors.
- Promote widespread sharing of safety-related information, procedures and lessons learned with first responders, authorities having jurisdiction and other stakeholders.
- Develop a robust supporting research and development program to provide critical hydrogen behavior data and a detailed understanding of hydrogen combustion and safety across a range of scenarios, needed to establish setback distances in building codes and minimize the overall data gaps in codes and standards development.
- Support and facilitate the completion of technical specifications by the International Organization for Standardization (ISO) for gaseous hydrogen refueling (TS 20012) and standards for on-board liquid (ISO 13985) and gaseous or gaseous blend (ISO 15869) hydrogen storage by 2009.

- Support and facilitate the effort, led by the National Fire Protection Association (NFPA), to complete the draft Hydrogen Technologies Code (NFPA 2) by 2008.
- With experimental data and input from Technology Validation Program element activities, support and facilitate the completion of standards for bulk hydrogen storage (e.g., NFPA 55) by 2008.
- Facilitate the adoption of the most recently available model codes (e.g., from the International Code Council [ICC] and NFPA) in key regions.
- Complete preliminary research and development on hydrogen release scenarios to support the establishment of setback distances in building codes and provide a sound basis for model code development and adoption.
- Support and facilitate the development of Global Technical Regulations (GTR) by 2010 for hydrogen vehicle systems under the United Nations Economic Commission for Europe, World Forum for Harmonization of Vehicle Regulations and Working Party on Pollution and Energy Program (ECE-WP29/GRPE).
- Support and facilitate the completion by 2012 of necessary codes and standards needed for the early commercialization and market entry of hydrogen energy technologies.

FY 2007 Technology Status

The sub-program utilizes the expertise of the Pacific Northwest National Laboratory (PNNL) Hydrogen Safety Panel to evaluate the safety plans and practices of DOE-funded projects against a panel-developed protocol. This activity provides suggestions on safety improvements and “lessons learned” that can be of broad benefit to the DOE Hydrogen Program. The panel, its services, and its work products are assets to funded-project teams who perform their own risk assessment and mitigation planning and are responsible for their own safe operating practices. In this manner, the panel helps to disseminate hydrogen safety best practices throughout the DOE Hydrogen Program.

To help fill the void of publicly available hydrogen safety data, the sub-program has developed and published three online hydrogen safety information resources: the Hydrogen Incidents Database, the Safety Bibliographic Database, and a Technical Reference for Hydrogen Compatibility of Materials. The Hydrogen Incidents Database, developed by PNNL, catalogs all hydrogen incidents and near-misses at DOE-funded projects and elsewhere. This resource is available at <http://www.h2incidents.org>. The Safety Bibliographic Database, developed by the National Renewable Energy Laboratory, was established in response to a recommendation from the National Research Council¹. The Safety Bibliographic Database contains over 400 publicly available hydrogen safety-related reports, papers, and presentations, allowing researchers, code officials, stakeholders to learn from others’ experiences, and is available at http://www.hydrogen.energy.gov/biblio_database.html. The Technical Reference, developed by Sandia National Laboratories, contains a compilation of hydrogen-compatible materials and properties, which is available at <http://www.ca.sandia.gov/matlsTechRef/>.

In addition, the Safety, Codes and Standards and Education sub-programs launched an online *Introduction to Hydrogen Safety for First Responders* course. The seven-module, web-based course provides an “awareness-level” overview of hydrogen for fire, law enforcement, and emergency medical personnel and has been accessed by nearly 4,500 users in the first seven months since its launch.

Internationally, the sub-program has been involved in a number of activities that span both codes and standards and safety. DOE provides support for the International Partnership for a Hydrogen Economy (IPHE) and the International Energy Agency (IEA), both of which have been engaged in hydrogen safety work. In addition, through the Los Alamos National Laboratory, DOE continues to work with the Department of Transportation to support their role as U.S. representative to the UN GTR process.

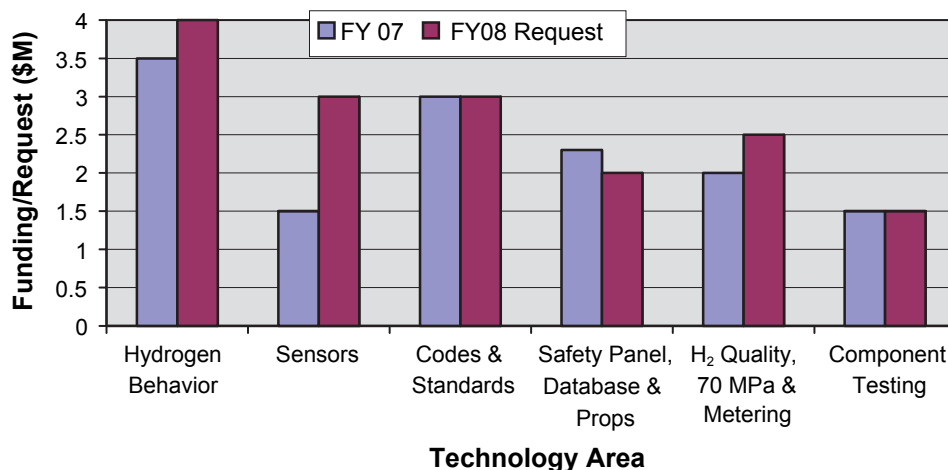
¹ National Research Council, *Review of the Research Program of the FreedomCAR and Fuel Partnership*, Washington, D.C.: The National Academies Press, 2005, p. 39.

FY 2007 Accomplishments

- The Hydrogen Safety Panel (11 members plus two direct support staff) held two panel meetings, reviewed 39 safety plans, and conducted five site visits.
- Engaged members of the building code and fire safety community in the development of safety information tools for the permitting of hydrogen fueling stations, including a national workshop in conjunction with the National Association of State Fire Marshals.
- Completed first version of *Technical Reference for Hydrogen Compatibility of Materials*, available at <http://www.ca.sandia.gov/matlsTechRef/>.
- Began R&D to support development of a hydrogen quality specification.
- Developed safety information materials for emergency responders and authorities having jurisdiction with the Education sub-program and industry groups.
- Updated and improved a searchable, online Hydrogen Incidents Database (www.h2incidents.org) to catalog hydrogen related incidents (without attribution), including causes, severity, lessons learned and corrective action.
- Updated and improved an online Hydrogen Safety Bibliographic Database (www.hydrogen.energy.gov/biblio_database.html) with over 400 references to hydrogen safety related publications. All of the entries include abstracts and many are downloadable from the website.

Budget

The sub-program received the full budget request for FY 2007. This increased funding, coupled with the lack of Congressionally-directed projects, allowed for the restart of hydrogen sensor R&D as well as hydrogen behavior, hydrogen quality, and risk assessment R&D that supports the codes and standards development process, and increased support for safety training. The budget request for FY 2008 would allow the sub-program to continue this work; a competitive solicitation for hydrogen safety sensors is also envisioned.



FY 2008 Plans

The Hydrogen Safety Panel will continue to promote safe practices for all DOE-funded projects by conducting safety plan reviews and site visits. Continued development of a safety information program to aid in the training of first responders and authorities having jurisdiction will be co-sponsored by the Education sub-program, with life-size training aids (“props”) sponsored by the Safety, Codes and Standards sub-program. Widespread sharing of data and information related to hydrogen safety will be continued through industry participation, publications, and an online hydrogen safety Best Practices Manual. The hydrogen safety Best Practices Manual will be published in early 2008 and will regularly compile safety-related information for the hydrogen community. A risk communication strategy will also be developed to guide officials on effective ways to communicate hydrogen risk information to the public in order to build and maintain public trust.

The hydrogen incidents database will be updated and maintained in FY 2008 to promote hydrogen safety through publishing details of hydrogen incidents and “lessons learned.” Future enhancements to the H2Incidents.org website will include graphical trend tools for displaying and reporting information. Cooperation with the European HySafe safety incidents database is also planned, as well as coordination with code organizations and other stakeholders.

The Technical Reference for Hydrogen Compatibility of Materials is a living document that is evolving as data is collected from the literature and generated from materials testing. Sections on pipeline steels and aluminum alloys will be added in the coming year. Additional content will be prioritized in cooperation with stakeholders (such as the American Society of Mechanical Engineers).

R&D to support the development of a hydrogen quality standard will continue in FY 2008. Working in cooperation with the Fuel Cell sub-program, this activity will initially focus on fuel cell hydrogen quality requirements. The sub-program will also continue risk assessment activities and initiate component testing work that supports risk assessment and codes and standards development.

In addition, the sub-program hopes to expand research and development efforts in the area of hydrogen leak detection technologies, such as sensors. Assuming appropriate levels of funding, a competitive solicitation for hydrogen safety sensors is planned for FY 2008.



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