
IX. SAFETY, CODES & STANDARDS

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

Introduction

Codes and standards development requires coordination of activities across government agencies, industry associations, corporate and international stakeholders, and codes and standards development organizations. To this end, the Safety, Codes & Standards Sub-Program leads collaborative domestic and international efforts to prepare, review, and promulgate the codes and standards needed to expedite hydrogen infrastructure development and to help enable the emergence of hydrogen as a significant energy carrier on a global scale.

The Safety, Codes & Standards Sub-Program supports research to provide a scientific basis for requirements incorporated in hydrogen codes and standards and facilitates the development of codes and standards for hydrogen use in transportation, stationary, and portable applications. This collaborative activity among government, industry, universities, and national laboratories is an integral part of an internationally supported effort. The activity also supports the development and implementation of practices and procedures to ensure safety in the operation, handling, and use of hydrogen and hydrogen systems for all DOE-funded projects.

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

Communication among codes and standards stakeholders is emphasized to maximize the impact of safety activities. All of the non-confidential data and information obtained through safety activities are made available through public presentations and the Program's online information resources. Safety information materials created to enhance the knowledge of emergency responders and local authorities are made available through various media to the largest number of safety personnel possible. In addition, planning efforts supporting future activities are conducted through open workshops to ensure stakeholders are properly and thoroughly engaged.

Goals

- Enable and facilitate the appropriate research, design, and development for the development of safe, performance-based, technical codes and standards that support technology readiness and are appropriate for widespread consumer use of fuel cell and hydrogen-based technologies.
- Facilitate the development and harmonization of domestic and international codes and standards. Complete research and development (R&D) to support essential codes and standards by 2010.
- Develop and implement the agreed upon safety practices and procedures that will ensure the safe 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.

Objectives

- Support and facilitate the completion of necessary codes and standards needed for the early commercialization and market entry of hydrogen and fuel cell energy technologies.
- 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 effort, led by the National Fire Protection Association (NFPA), to complete the draft Hydrogen Technologies Code (NFPA 2) by 2010.
- Facilitate the adoption of the most recent, available model codes (e.g., International Code Council [ICC] and NFPA) in key regions through education and training for code officials.

- Develop a comprehensive safety plan in collaboration with industry that establishes Program safety policies and guidelines by 2010. DOE will utilize the Hydrogen Safety Panel's expertise and assistance in conducting safety evaluations and identifying safety-related technical data gaps, lessons learned and best practices.
- Promote the widespread sharing of safety-related information and knowledge tools with first responders (authorities having jurisdiction) and other stakeholders.
- Support and facilitate the development of Global Technical Regulations (GTR) 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) by 2010.

FY 2009 Technology Status

The Safety, Codes & Standards Sub-Program utilizes the expertise of the Hydrogen Safety Panel to evaluate the safety plans and practices of DOE-funded projects. This activity provides recommendations on the safe conduct of project work and lessons learned/best practices that can be of broad benefit to the DOE Hydrogen Program. The panel, its services and work products are assets to DOE-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.

To help fill the void of publicly available hydrogen safety data, the Sub-Program has developed and published five online hydrogen safety information resources:

- The Hydrogen Incidents and Lessons Learned Database¹, developed by Pacific Northwest National Laboratory (PNNL), catalogs hydrogen incidents, near-misses and lessons learned from a variety of sources including DOE-funded projects.
- The Hydrogen Safety Bibliographic Database, developed by the National Renewable Energy Laboratory (NREL), was established in response to a recommendation from the National Research Council.² The Hydrogen Safety Bibliographic Database³ contains more than 500 publicly available hydrogen safety-related reports, papers, and presentations, allowing researchers, code officials, and stakeholders to learn from others' experiences.
- The Hydrogen Safety Best Practices Manual⁴ developed by PNNL and Los Alamos National Laboratory, contains nine hierarchical, peer-reviewed sections on best practices and is cross-referenced with the Hydrogen Incidents and Lessons Learned and Hydrogen Safety Bibliographic Databases.
- The Permitting Compendium for Hydrogen Facilities⁵, developed by NREL, is a one-stop information resource to facilitate the permitting of hydrogen fueling stations and stationary fuel cell installations.
- Technical Reference for Hydrogen Compatibility of Materials⁶, developed by Sandia National Laboratories, contains a compilation of hydrogen-compatible materials and properties.

In addition, the Safety, Codes & Standards and Education Sub-Programs launched an online *Introduction to Hydrogen Safety for First Responders* course. The seven-module, Web-based course provides an overview of hydrogen technologies and applications for fire, law enforcement, and emergency medical personnel. The Web-based course has averaged 300-500 unique visits/month and over 9,300 visits since its launch in January 2007.

¹ This resource is available at <http://www.h2incidents.org>.

² National Research Council, *Review of the Research Program of the FreedomCAR and Fuel Partnership*, Washington, D.C.: The National Academies Press, 2005, p. 39.

³ http://www.hydrogen.energy.gov/biblio_database.html/

⁴ <http://www.h2bestpractices.org/>

⁵ <http://www.hydrogen.energy.gov/permitting/>

⁶ <http://www.ca.sandia.gov/matlsTechRef/>

The Safety, Codes & Standards Sub-Program provides support for the International Partnership for a Hydrogen Economy and the International Energy Agency, both of which have been engaged in hydrogen safety work. Additionally, DOE continues to work with the Department of Transportation to support its role as U.S. representative to the UN GTR process.

FY 2009 Accomplishments

- Developed the technical basis for assessing the safety of hydrogen-based systems for use in the development and modification of relevant codes and standards, which has introduced a risk-informed approach for separation distances into NFPA 55 (Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders) 2009 code cycle in June 2009.
- Engaged members of the building code and fire safety community in the development of safety information tools for the permitting of hydrogen fueling stations and hydrogen fuel cells for telecommunications backup power. More than 250 code officials have been trained to date.
- Established better coordination among international teams and accelerated R&D to support the development of a draft international hydrogen fuel quality standard for proton exchange membrane fuel cells in road vehicles by 2010.
- The Hydrogen Safety Panel has reviewed more than 200 safety plans, and conducted 37 site visits and telephone interviews since its inception. The panel provides expertise and guidance to DOE and assists with identifying safety-related technical data gaps through technical white papers.
- Completed upgrade of Web-based *Introduction to Hydrogen Safety for First Responders*. This multimedia tutorial acquaints first responders with hydrogen, its basic properties, and how it compares with like fuels.
- Completed development and conducted inaugural advanced-level training course that includes a hands-on fuel cell vehicle prop. This course is the first of its kind in the United States and is aimed at first-responders dealing with hydrogen-related incidents, with more than 90 first responders from 18 states participating or on a waiting list.
- Updated and improved the online hydrogen safety databases including the Hydrogen Incidents and Lessons Learned Database, Hydrogen Safety Bibliographic Database, and the Hydrogen Safety Best Practices Manual.
- Published “H2 Safety Snapshot” as a topical newsletter.

Budget

The Sub-Program received an appropriation of \$12.5 M for Fiscal Year 2009. This funding allowed for sustained progress on hydrogen release behavior, hydrogen fuel quality, quantitative risk assessment, and leak detection research to support the codes and standards development process. In addition, work has started on a codes and standards gap analysis for the Vehicle Technologies Program.

The President’s FY 2010 budget realigns the Program to focus on nearer term priorities for our Nation’s most pressing energy needs. As part of the realignment, no funding for Safety, Codes and Standards was requested.

2010 Plans

The applied R&D program in the Office of Energy Efficiency and Renewable Energy will coordinate with the Office of Science, which plans to include up to \$50 M of basic research related to hydrogen and fuel cell technologies. In addition, through the projects funded by the American Recovery and Reinvestment Act of 2009 lessons learned, best practices related to hydrogen and fuel cell safety, codes and standards will be documented.

Final reports documenting progress will be issued in FY 2010. The Safety, Codes and Standards Sub-Program will continue to coordinate the efforts of codes and standards organizations to identify and address the gaps, clarify and consolidate regulations, validate outdated test results, and ultimately develop new, more appropriate codes and standards. The Sub-Program will be working with the

Department of Transportation and other hydrogen experts on a hydrogen and natural gas lessons learned workshop. The focus of this workshop will be to coordinate and harmonize lessons learned and activities among the compressed natural gas and hydrogen industry, stakeholders and experts. This workshop will provide a foundation to help shape the path forward in policy, regulation, and codes and standards. In addition the Safety, Codes & Standards Sub-Program will continue to perform research and development to minimize the knowledge gap in safety, and enable solid codes and standards to be developed.

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