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

### Introduction

The Safety, Codes & Standards sub-program supports research and development (R&D) that provides critical information needed to define requirements and close gaps in codes and standards and safety to enable the widespread commercialization and safe deployment of hydrogen and fuel cell technologies. In FY 2010 the sub-program focused on continuing to identify risk management measures to reduce the risk and mitigate the consequences of potential incidents that could hinder the commercialization of these technologies.

The sub-program continues to promote collaborative activity among government, industry, standards development organizations (SDOs), universities, and national laboratories in an effort to harmonize regulations, codes and standards (RCS) both internationally and domestically. Communication and collaboration among codes and standards stakeholders is emphasized by the sub-program to maximize the impact of its efforts and activities in international RCS.

In addition to R&D, the sub-program's safety activities focus on development of information resources and best practices. The sub-program utilizes extensive external stakeholder input—from the fire-protection community, academia, automobile manufacturers, and the energy, insurance, and aerospace sectors—to create and enhance safety knowledge tools for emergency responders and authorities having jurisdiction. Continual availability of safety knowledge tools, distributed via an array of media outlets to reach the largest number of safety personnel possible, is a renewed priority. The sub-program also supports the development and implementation of best practices and procedures to ensure safety in the operation, handling, and use of fuel cell and hydrogen technologies for Hydrogen Program-funded projects.

### Goals

The sub-program's aim is to provide the validated scientific and technical basis required for the development of codes and standards and to implement safety practices and procedures to allow for the safe deployment of hydrogen and fuel cell technologies. The goals are to:

- Conduct and facilitate the appropriate R&D for the development of scientifically and technically sound codes and standards that enable the safe use of hydrogen and fuel cell technologies.
- Facilitate the development and harmonization of domestic and international RCS by seeking the consensus of all major stakeholders via the sub-program's continued support of R&D that produces critical data and information needed to define requirements and fill gaps in codes and standards.
- Ensure that safety is a critical priority in research, technology development, and market deployment of hydrogen and fuel cell technologies.
- Develop and implement safety practices and procedures that will ensure the safe operation, handling, and use of hydrogen and fuel cell technologies, and utilize these practices and lessons-learned to promote the safe use of hydrogen and fuel cell technologies in Hydrogen Program-funded projects.
- Promote widespread sharing of safety-related information, procedures, and lessons-learned with first responders, authorities having jurisdiction, and other stakeholders.
- Understand and mitigate risk, to facilitate the safe use and insurability of hydrogen and fuel cell technologies.

### Objectives

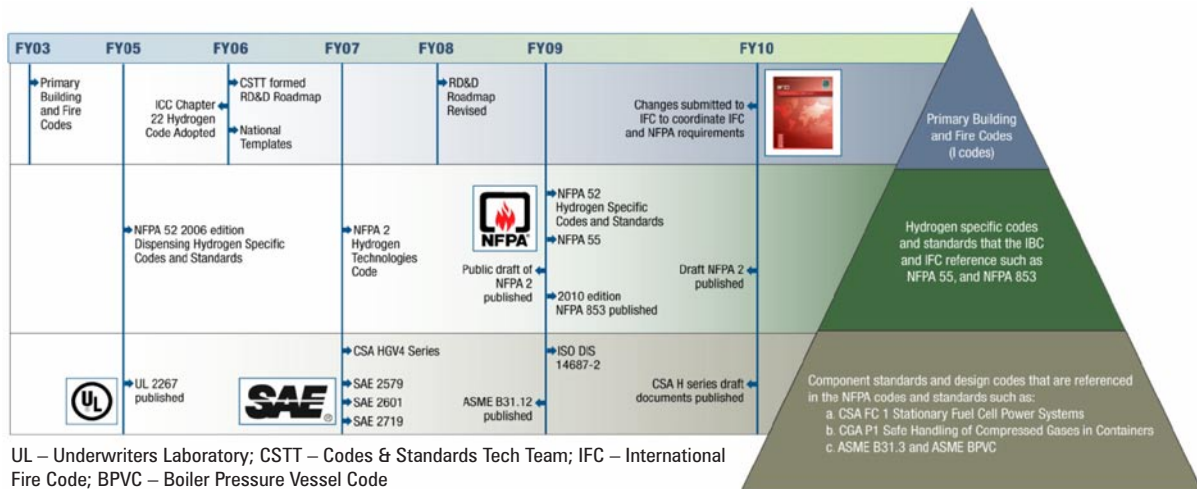
The sub-program's objectives are to:

- Support and facilitate the promulgation of essential codes and standards by 2015 to enable the widespread commercialization and market entry of these technologies.

- Facilitate uniform implementation of requirements in codes and standards throughout the United States by 2015.
- Support and facilitate the completion of all essential domestic and international RCS by 2020.
- Support and facilitate the development of the Phase I Global Technical Regulations for hydrogen-fueled vehicles under the United Nations Economic Commission for Europe, World Forum for Harmonization of Vehicle Regulations and Working Party on Pollution and Energy Program (UN ECE-WP29/GRPE) by 2012 and Phase II by 2015.

## FY 2010 Technology Status

The sub-program continues to support R&D to provide the technical basis for codes and standards development with specific projects in a wide range of areas such as fuel specification, separation distances, materials and components compatibility, and hydrogen sensor technologies. Utilizing the results from this R&D, the sub-program continues to actively participate in discussions with SDOs such as the National Fire Protection Association (NFPA), International Code Council (ICC), Society of Automotive Engineers (SAE), Canadian Standards Association (CSA), and International Organization for Standardization (ISO) to promote domestic and international collaboration and harmonization of RCS. Figure 1 gives an overview of codes and standards development work:



**FIGURE 1.** Overview of Codes & Standards Development Work

The sub-program also utilizes the expertise of the Hydrogen Safety Panel to evaluate the safety plans and practices of Hydrogen Program-funded R&D 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 Program. The Hydrogen Safety Panel has taken the lead in reviewing fuel cell deployments under the American Recovery and Reinvestment Act (ARRA) by forming a team to conduct reviews of ARRA project safety plans, safety reviews, and site visits. As high-profile examples of early market deployments, it is especially important these projects are conducted in a safe and effective manner.

After initial pilot deployments of the advanced-level, prop-based course for first responders, the official course was rolled out to first responders in FY 2010. This rigorous eight-hour course uses a hydrogen fuel cell vehicle burn prop to provide first responders with hands-on experience and training. The course was developed with input from a steering committee made up of representatives from automobile manufacturers, energy companies, and the fire safety community. The course was deployed in three locations in August and September 2010.

The sub-program actively participates in the International Partnership for Hydrogen and Fuel Cells in the Economy Regulations, Codes and Standards Working Group and the International Energy Agency Hydrogen Implementing Agreement, both of which have been engaged in hydrogen safety work. Additionally, DOE continues to work with the Department of Transportation (DOT) to support its role as the U.S. representative to the UN ECE-WP29/GRPE to develop a global technical regulation for hydrogen-fueled vehicles.

## FY 2010 Accomplishments

In FY 2010, the sub-program:

- Developed the technical basis for assessing the safety of hydrogen-based systems, which will be used in the development and modification of relevant codes and standards. This technical basis has introduced a risk-informed approach that enabled NFPA2 to update bulk gas storage separation distances in the 2010 edition of NFPA55.
- Completed additional materials and components compatibility work, including updates to the *Technical Reference for Hydrogen Compatibility*<sup>1</sup> and completed testing to enable the deployment of 100-MPa stationary storage tanks; also supported the development of codes and standards for forklifts, including tank lifecycle testing, for use by the CSA Hydrogen Powered Industrial Truck Committee.
- Expanded and improved online hydrogen safety resources, including *Hydrogen Incidents and Lessons Learned*,<sup>2</sup> *Hydrogen Safety Bibliographic Database*,<sup>3</sup> and the *Hydrogen Safety Best Practices Manual*.<sup>4</sup>
- Developed and published the “H<sub>2</sub> Safety Snapshot,” a quarterly newsletter promoting safety best practices.
- Developed and published a Web-based educational course addressing *Hydrogen Safety Training for Researchers*<sup>5</sup>—the four-hour course has six modules and highlights best practices for the safe use of hydrogen in a research setting.
- 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—this includes the expansion of the *Permitting Compendium for Hydrogen Facilities*.<sup>6</sup>
- Conducted hydrogen permitting workshops, which have reached over 250 code and permitting officials.
- Expanded outreach to code officials through four in-person workshops, an updated *Introduction to Hydrogen Safety for Code Officials*<sup>7</sup> Web-based training course, and case studies documenting the permitting process for two early market fuel cell installations in conjunction with the Education sub-program. The codes and standards workshops, held in collaboration with local fire department and government organizations, were expanded to include additional modules on electric vehicles and infrastructure. The electronic learning package was updated with material on indoor hydrogen fueling to support the increasing number of fuel cell material handling equipment deployments. To support Market Transformation, the Education and Safety, Codes and Standards sub-programs were asked to evaluate, assist with and document the permitting of a backup-power fuel cell system and a fleet of fuel cell forklifts at two Department of Defense sites. The results were published as case studies to assist code officials and project developers in understanding the codes and standards and safety evaluations for similar early market installations.
- Continued to deploy the advanced-level, prop-based course for first responders in coordination with the Education sub-program. Two pilot sessions of the prop-based course were held at the

<sup>1</sup> <http://www.ca.sandia.gov/matlsTechRef/>

<sup>2</sup> <http://www.h2incidents.org/>

<sup>3</sup> [http://www.hydrogen.energy.gov/biblio\\_database.html/](http://www.hydrogen.energy.gov/biblio_database.html/)

<sup>4</sup> <http://www.h2bestpractices.org/>

<sup>5</sup> <https://www-training.llnl.gov/training/hc/HS5094DOEW/index.html#>

<sup>6</sup> <http://www.hydrogen.energy.gov/permitting/>

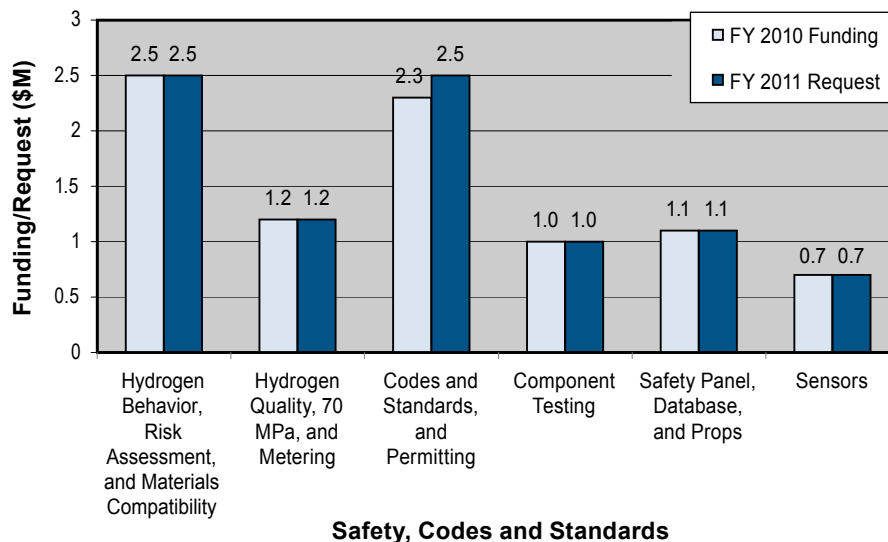
<sup>7</sup> [http://www.hydrogen.energy.gov/training/code\\_official\\_training/](http://www.hydrogen.energy.gov/training/code_official_training/)

Hazardous Materials Management and Emergency Response training center in 2009. The course was conducted three times in the state of California in 2010. More than 300 students from 18 states have been trained.

- Expanded the reach of the Web-based educational course *Introduction to Hydrogen Safety for First Responders*.<sup>8</sup> This multimedia tutorial acquaints first responders with hydrogen, its basic properties, and how it compares with other fuels. The Web-based course has received over 17,000 unique visitors and is averaging 300–500 unique visitors each month from almost every state and many countries.
- Co-hosted, with the DOT, an international workshop for compressed natural gas (CNG) and hydrogen in December 2009. The workshop included participants from national laboratories and industry as well as international representatives from Brazil, India, Canada, China, and the United States. The workshop promoted the exchange of information among experts in CNG and hydrogen for vehicles, facilitated the sharing of lessons-learned from the deployment of these vehicles, and identified opportunities for international R&D collaboration.
- Held an Early Market Fuel Cell Technologies Workshop in April 2010 at Sandia National Laboratories (SNL). The workshop promoted the exchange of information among industry, government, national laboratories, SDOs, and other relevant stakeholders to enable the early market deployment of fuel cell technologies.
- Held a Vehicular Tank Workshop in April 2010 at SNL, which included participants from industry, government, national laboratories, SDOs, and other relevant stakeholders to coordinate R&D and RCS to enable the deployment of hydrogen storage tanks.

## Budget

The sub-program received an appropriation of \$8.8 million for FY 2010. This allowed for sustained progress in R&D, codes and standards development, and safety. The President's FY 2011 budget request is \$9 million, as shown below.



<sup>8</sup> <http://www.hydrogen.energy.gov/firstresponders.html>

## FY 2011 Plans

The Safety, Codes & Standards sub-program will continue to work with codes and standards organizations to identify and address gaps to develop new hydrogen-specific codes and standards. To address these challenges, the sub-program will continue to support its rigorous technical R&D program.

In FY 2011, the sub-program will perform a technology status assessment of hydrogen sensors and their related targets. In addition, insurability for fuel cell and hydrogen technologies will be assessed through an international forum. In FY 2011 and beyond, the sub-program will continue to focus on critical safety R&D, such as assessment of materials compatibility for component designs, high-pressure tank cycle testing, and promoting a quantitative risk assessment approach to ensure the development of technically sound codes and standards. The sub-program will continue to promote the domestic and international harmonization of RCS.

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