

Hydrogen Codes and Standards

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Clean Vehicle Education Foundation, Washington, DC

CSA America, Inc., Cleveland, OH

LCC, Ltd., Clementon, NJ

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Objectives

- Facilitate creation and adoption of model building codes and equipment standards for hydrogen systems in commercial, residential, and transportation applications.
- Provide technical resources to harmonize development of international standards among the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), and Working Party on Pollution and Energy (GRPE).

Technical Barriers

This project addresses the following technical barriers from the Codes and Standards section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year R,D&D Plan:

- A. Limited Government Influence on Model Codes
- B. Competition between ICC and NFPA
- C. Limited State Funds for New Codes
- D. Large Number of Local Government Jurisdictions (approximately 44,000)
- E. Officials Training Differences
- F. Limited DOE Role in the Development of ISO Standards
- G. Inadequate Representation by Government and Industry at International Forums.
- H. International Competitiveness
- I. Strategic Conflicts between Domestic and International Standards Objectives
- J. Consensus National Agenda on Codes and Standards
- K. Lack of Domestic Industry Support at International Technical Committees
- L. Competitiveness in Copyright of Published Standards
- M. MNFPA 55 has not yet been completed, but is currently in progress
- N. Lack of Technical Data to Revise NFPA 55 Standard (for underground and aboveground storage)
- P. Current Large Footprint Requirements for Hydrogen Fueling Stations

Approach

- Support and facilitate the timely and efficient incorporation of hydrogen safety issues into existing and proposed codes and/or standards promulgated by organizations such as the International Code Council (ICC), National Fire Protection Association (NFPA), Society of Automotive Engineers (SAE), and ISO.
- Support and encourage technical and operational consistency among and across the codes and standards developed by different organizations.
- Disseminate and share information on development of codes and standards.
- Identify critical gaps and deficiencies in codes and standards and formulate recommendations for addressing them.
- Familiarize building code officials, fire safety officials, local/state/federal policymakers, and other strategic stakeholders (e.g., homebuilders, architects, transportation regulators) with hydrogen technologies and the related codes and standards.
- Create "national template" to harmonize standards, codes, and regulations.
- Develop generic licensing agreement for web-based access to standards.
- Develop training modules and conduct workshops with ICC and NFPA.
- Develop unified national agenda and support consistent representation of technical experts from industry and government at key global venues.
- Develop comprehensive R&D plan and program for validation of codes and standards.
- Actively seek opportunities to work collaboratively with other DOE programs and non-federal organizations involved in hydrogen-related codes and standards efforts to streamline codes and standards development and minimize duplication of efforts.

Accomplishments

- Hydrogen safety incorporated in 2003 edition of ICC model codes.
- Developed draft template for national standards, codes, and regulations for hydrogen vehicles, fueling/service/parking facilities, vehicle/facility interface, and on-site hydrogen generation, and for stationary and portable fuel cells.
- Testing underway to establish technical basis for separation distances for safe bulk storage of hydrogen.
- Draft performance-based regulations for compressed and liquid hydrogen storage for vehicles completed by United Nations-European Economic Council Working Party on Pollution and Energy (UN-ECE/GRPE) informal group on Hydrogen/Fuel Cells.
- Standards under development and on-going coordination with American Society of Mechanical Engineers (ASME) Hydrogen Steering Committee; Underwriters Laboratory (UL) Standards Technical Panel 2264 Hydrogen Generators; NFPA Hydrogen Coordination Committee; CSA America Technical Advisory Group for on-board gaseous hydrogen container standard; International Hydrogen Infrastructure Group Codes and Standards Working Group; California Fuel Cell Partnership Codes and Standards Working Group; and Working Group for Emergency Response Guide for Fuel Cell Buses, U.S. Fuel Cell Council Codes and Standards Working Group.
- Organization agreements among U.S., Canada, and Japan in place for Partnership for Advancing the Transition to Hydrogen (PATH).

Future Directions

- Refine overall codes and standards coordination program.
- Create centralized, publicly accessible web-based data center.

- Negotiate DOE license from primary standard and code development organizations.
- Create one-stop technical assistance for hydrogen projects including directory of primary contacts for information and technical assistance.
- Convene annual safety, codes, and standards summit meeting.
- Initiate comprehensive R&D plan for validation of standards.
- Develop hydrogen safety training packages for local code officials with NFPA and ICC.
- Identify and fund appropriate experts to fully participate in development of Global Technical Regulations for on-board storage and other hydrogen-related regulations under development.
- Develop Global Technical Regulations for hydrogen fuel cell vehicles that include harmonized regulations for on-board hydrogen storage and are harmonized with U.S. Federal Motor Vehicle Safety Standards.
- Develop harmonized standards for fuel cell power plants.

Introduction

The development and promulgation of codes and standards are essential if hydrogen is to become a significant energy carrier and fuel. Codes and standards are critical to establishing a market-receptive environment for commercializing hydrogen-based products and systems. With the help of key stakeholders, the Hydrogen, Fuel Cells & Infrastructure Technologies Program of the U.S. Department of Energy (DOE) and the National Renewable Energy Laboratory (NREL) are coordinating a collaborative national effort by government and industry to prepare, review, and promulgate hydrogen codes and standards needed to expedite hydrogen infrastructure development.

DOE has sponsored work in codes and standards as a key part of its efforts since 1995. The initial efforts included support for the National Hydrogen Association (NHA) to conduct national codes and standards workshops at least annually to bring together experts to address key issues and needs. These and other efforts sponsored by DOE have encouraged organizations such as the International Code Council (ICC), the National Fire Protection Association (NFPA), the Society of Automotive Engineers (SAE), Underwriters Laboratory (UL), and the Compressed Gas Association (CGA) to conduct national activities in hydrogen codes and standards. Federal agencies such as the Department of Transportation (DOT), the National Aeronautics and Space Administration (NASA), and the National Institute of Standards and Technology (NIST) also have regulatory or mission-related interests in

hydrogen regulations, codes, and standards. Under this project, DOE has assumed leadership in accelerating the creation and adoption of a harmonized set of national and international standards, codes, and regulations that are essential for the safe use of hydrogen by consumers in the U.S. and worldwide.

Approach

The federal government has an indirect and relatively limited role in the voluntary consensus process through which codes and standards are developed in the U.S. Because of the importance of establishing a harmonized set of standards upon which model codes and regulations can be based, DOE, primarily through NREL, has devoted considerable effort to facilitate and coordinate this consensus process. Much of this effort is carried forth through the DOE Hydrogen Codes and Standards Coordinating Committee (HCSCC). In addition to serving as the database repository, clearinghouse, and gatekeeper for the codes and standards activities being conducted within DOE, the HCSCC also collaborates with other national and international organizations involved in codes and standards activities. The HCSCC conducts monthly conference calls to update participants on current activities and to discuss key issues and convenes quarterly meetings to:

- Coordinate codes and standards development efforts and prevent duplication of efforts,
- Identify critical deficiencies and gaps in hydrogen codes and standards development efforts that

could adversely impact market acceptance and penetration,

- Collaboratively determine a strategy and action plan to address critical gaps and deficiencies, and
- Identify specific opportunities for organizations to work collaboratively in developing codes and standards.

Once developed, standards are usually incorporated into model codes that, in turn, must be adopted by state and local jurisdictions to have the force of law. In 2001, the model codes of the ICC did not include hydrogen as an energy source or fuel cells as either power-generating devices or appliances. To address this limitation, the ICC established an Ad Hoc Committee (AHC) on hydrogen technologies, at the request of DOE, to reduce the time needed to have the model codes amended to include hydrogen technologies. As part of a collaborative process, DOE sponsored the participation of experts to the AHC to help ensure a balanced membership of hydrogen users, producers, and regulator interests. This process was successful, and the 2003 edition of the ICC model codes contain provisions for hydrogen use in and around buildings and consumer facilities.

In addition to sponsoring activities related to ISO TC197 and other international standards development organizations (SDOs), DOE is helping to organize the Partnership for Advancing the Transition to Hydrogen (PATH) to link and unify hydrogen interests of the U.S., Canada, Japan, Argentina, and other countries in the Pacific Rim and the Americas. The goals of PATH are to identify and build on a community of interest among members by addressing common issues and to increase knowledge and activities concerning hydrogen, particularly safety and codes and standards. PATH will also help interested hydrogen parties in non-member countries to organize hydrogen activities and contribute to the strengthening of the international hydrogen community.

Results

The key results of the domestic codes and standards effort were the inclusion of hydrogen applications in the 2003 edition of the ICC model codes and the creation of "national templates"

through which DOE, NREL, and the major SDOs and model code organizations will coordinate the preparation of critical standards and codes for hydrogen technologies and applications. Provisions for the safe use of hydrogen are now incorporated in the ICC's International Building, Residential, Fire, Mechanical, and Fuel Gas Codes. Additional work to reduce the footprint of hydrogen fueling stations will be considered under the ICC's 2003-04 code cycle that, if successful, will be incorporated in the 2006 edition of the ICC model codes.

The draft template for hydrogen applications on vehicles and in fueling, service, and parking facilities is shown in Figure 1. The draft template for on-site hydrogen generation and for stationary and portable fuel cells is shown in Figure 2. The templates designate lead and supporting organizations for the standards and codes to be developed and were prepared in workshops by consensus of the organizations shown. This consensus overcomes the historic competitiveness among the organizations to develop and sell standards and model codes and is a

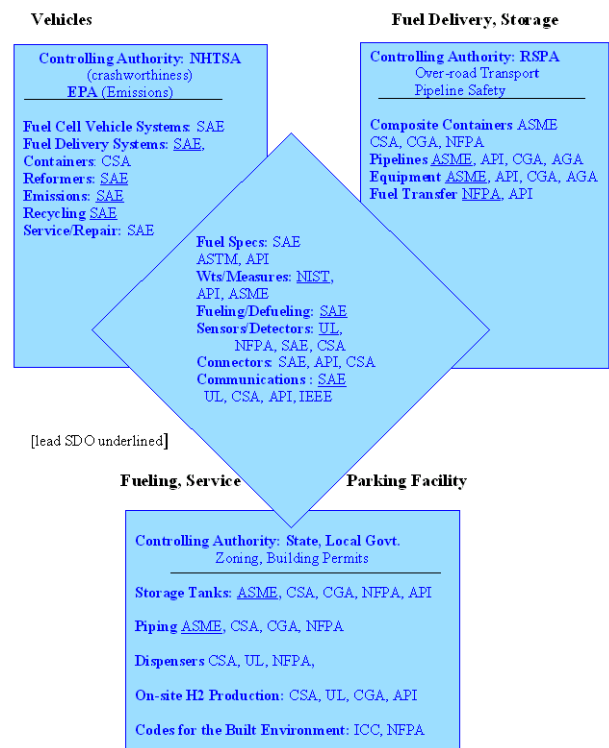


Figure 1. Draft Template for Vehicle Systems and Refueling Facilities

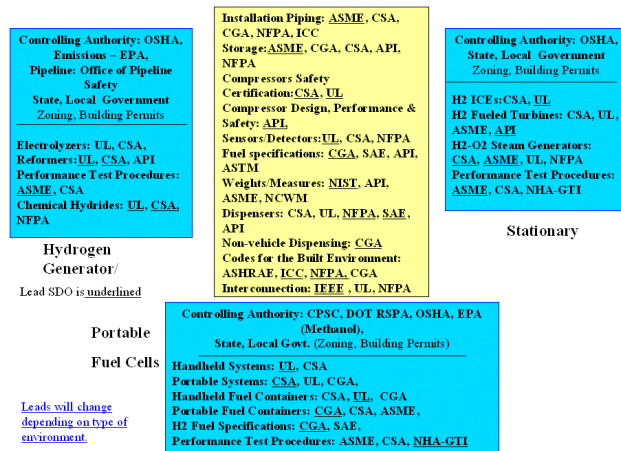


Figure 2. Draft Template for On-Site Hydrogen Generation and Fuel Cells

critical step in creating a collaborative and cooperative national agenda for hydrogen codes and standards.

The key results in international codes and standards were the launching of PATH and the strengthening of the collaboration among DOE, DOT, and the Environmental Protection Agency (EPA) in representing the interests of the U.S. government and industry at the GRPE. The DOE is now a full participant at international forums at which discussion and negotiations on global technical regulations affecting hydrogen take place. Internationally accepted hydrogen standards can facilitate trade among nations and lower regulatory trade barriers. If hydrogen is to become a major energy carrier, the hydrogen interests of key countries must be coordinated, and countries new to hydrogen must be introduced to its benefits and safe use.

Conclusions

DOE has supported a growing and increasingly important effort to coordinate the development and promulgation of hydrogen codes and standards. In addition to supporting specific projects to develop codes, such as that of the ICC/AHC, and standards, such as that of ISO TC197, the DOE is supporting the coordination of many other efforts so that codes and standards can be developed and adopted as efficiently as possible and so that the lack of codes and standards will not be a barrier to the commercialization of hydrogen technologies. Support of codes and standards efforts will remain an

important part of the Program for many years to come.

FY 2003 Publications/Presentations

1. Domestic Codes and Standards: DOE Status Report, Fuel Cell Summit VII, College Park, MD, May 2003.
2. Codes and Standards: The International Scene, Fuel Cell Summit VII, College Park, MD, May 2003.
3. Hydrogen Codes and Standards, Hydrogen, Fuel Cells and Infrastructure Technologies Program, 2003 Merit Review and Peer Evaluation Meeting, Berkeley, CA, May 2003.
4. Domestic Codes and Standards: DOE Status Report, International Hydrogen Infrastructure Working Group, The Woodlands, TX, May 2003.
5. Hydrogen Codes and Standards, National Hydrogen Association, Codes and Standards Workshop, Ft. Worth, TX, October, 2002.

Special Recognitions & Awards/Patents Issued

1. National Hydrogen Association Meritorious Service Award to Guy Tomberlin, Chair, ICC Hydrogen Ad Hoc Committee, March 6, 2003