

Hydrogen Codes and Standards

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Background

The development and promulgation of codes and standards are essential if hydrogen is to become a significant energy carrier and fuel because codes and standards are critical to establishing a market-receptive environment for commercializing hydrogen-based products and systems. The Hydrogen, Fuel Cells, and Infrastructure Technologies Program of the U.S. Department of Energy (DOE) and the National Renewable Energy Laboratory (NREL), with the help of the National Hydrogen Association (NHA) and other key stakeholders, 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. The DOE is devoting a significant portion of its budget to support the development and promulgation of hydrogen codes and standards. This paper provides an overview of the DOE's efforts to facilitate and coordinate the development of hydrogen codes and standards.

The DOE has sponsored work in codes and standards as a key part of its efforts since 1995. The initial efforts included support for the NHA to conduct national codes and standards workshops at least annually to bring together experts to address key issues and needs. These efforts have helped in encouraging organizations such as 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. It was also from the NHA workshops that proposals to form working groups to develop hydrogen standards under International Organization for Standards (ISO) Technical Committee (TC) 197 emerged. These proposed standards are in various stages of completion under the ISO process.

Another important effort initiated by the DOE was the preparation of the *Sourcebook for Hydrogen Applications*, published in 1998. The *Sourcebook* attempted to compile in a single volume key materials from existing sources to provide an overview and reference materials of prevailing practices and applicable standards and codes for the use of hydrogen as a fuel. The effort was jointly funded by the DOE and by Natural Resources Canada, sponsored jointly by the NHA and the Canadian Hydrogen Association, coordinated jointly by NREL and the Hydrogen Research Institute at the University of Quebec at Three Rivers, and prepared by a technical team of U.S. and Canadian experts.

International Code Council's Hydrogen Ad-hoc Committee

In an effort to prepare uniform national model building codes, the three major code councils in the U.S., the Building Officials Code Administration (BOCA), the International Conference of Building Officials (ICBO), and the Southern Building Code Congress International (SBCCI), established the ICC as a joint venture. The existing ICC model codes do not include hydrogen as an energy source or fuel cells as either a power-generating device or as an appliance. To address this limitation, the DOE sponsored a request to the ICC that it establish an Ad Hoc Committee (AHC) on hydrogen technologies, a process the other code bodies have used in the past to address new technologies and which can reduce the time needed to have the model codes amended to include hydrogen technologies. The ICC approved this request, and the Hydrogen Program has sponsored the participation of experts to the AHC. The AHC consists of a balanced membership of hydrogen user, producer, and regulator interests. It is working with a diverse group of technical and advisory parties to review current codes and standards applicable to hydrogen, to determine the adequacy of its coverage in the ICC International Codes, and to propose changes as necessary to those codes through the ICC Code Development Process. The AHC has held a number of meetings and prepared proposed amendments to the ICC model Building, Fire, Electrical, Mechanical, and Fuel Gas codes for hydrogen that will be up for final consideration at the ICC Code Hearing in October 2002.

DOE Hydrogen Codes and Standards Coordination Committee

The DOE Hydrogen Codes and Standards Coordinating Committee (HCSCC) was established earlier this year by the Hydrogen Program. The mission of the HCSCC is to coordinate the development and implementation of a consistent set of hydrogen-related codes and standards that will ensure the safe production, delivery, and use of hydrogen, and facilitate the accelerated commercialization of hydrogen technologies for stationary, transportation, and portable applications. In addition to serving as the data base repository, clearinghouse, and gatekeeper for the codes and standards activities being conducted within DOE, the HCSCC will also reach out to and collaborate with other national and international organizations involved in codes and standards activities to promote the sharing and dissemination of this information.

Specifically, the HCSCC will:

- 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 ICC, NFPA, SAE, and ISO
- Support and encourage technical and operational consistency among and across the codes and standards developed by different organizations
- Disseminate and share codes and standards development information
- 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, etc.) with hydrogen technologies and the related 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.

The participating members of the HCSCC to date include the DOE (Hydrogen Program, Transportation Fuel Cell Power Systems Program, Distributed Energy Resources Fuel Cell

Program, Hydrogen Technical Advisory Panel's Safety Committee), NHA, ICC, NASA, SAE, National Evaluation Services (NES), Natural Gas Vehicle Coalition (NGVC), Pacific Northwest National Laboratory (PNNL), and NREL. The NFPA is expected to participate in the near future.

The HCSCC conducts monthly conference calls to update participants on current activities and to discuss key issues. The HCSCC also convenes quarterly meetings at the NHA headquarters in Washington, DC. Two quarterly meetings have been held to date, and minutes of these meetings are available through the NHA. As part of its effort to coordinate the development of hydrogen codes and standards, the HCSCC will conduct workshop to provide a forum for key government and non-government organizations involved in developing codes and standards related to hydrogen technologies in order to:

- coordinate codes and standards development efforts and prevent duplications of efforts
- identify critical deficiencies and gaps in hydrogen codes and standards developments efforts that could adversely impact market acceptance and penetration
- determine collaboratively 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.

A draft plan to coordinate codes and standards will be considered and revised by the participants. One outcome of the workshop will be a matrix showing the activities, participants, and gaps in hydrogen codes and standards.

DOE Hydrogen Technical Advisory Panel

In 1992, the U.S. Congress established the Hydrogen Technical Advisory Panel (HTAP) to advise the Secretary of Energy on the implementation and conduct of the DOE's hydrogen RD&D program. The HTAP advises the Secretary on investment strategy and priorities for the research, development, and demonstration (RD&D) of advanced hydrogen energy technologies and on the economic, technical, and environmental consequences of deploying hydrogen energy systems. In 2001, the HTAP created a Safety Committee to address critical issues in hydrogen safety, including codes and standards. The mission of the Safety Committee is to enhance hydrogen safety in the U.S. hydrogen energy community with a major focus on DOE activities, programs, and projects. Its objectives are to:

- identify hydrogen safety concerns and issues throughout the hydrogen energy community
- determine current status and adequacy of hydrogen safety policies, regulations, codes, standards, and guidelines pertinent to the hydrogen energy community
- provide a national platform to air critical hydrogen safety issues that impact the hydrogen energy community
- provide representation to, or link with, any national or international codes and standards activity that will affect the interests of the hydrogen energy community
- provide input through the HTAP to enhance hydrogen safety through DOE policies and programs affecting the hydrogen energy community.

Under its action plan, the Committee will:

- conduct an annual Hydrogen Safety Summit in coordination with key governmental organizations and industry to define the current national baseline on hydrogen safety capability and to identify critical codes and standards needs and priorities
- hold regular meetings to monitor hydrogen safety and codes and standards activities

- prepare periodic reports based on this monitoring with special attention paid to regulatory barriers that may impede implementation of a national hydrogen energy infrastructure
- provide HTAP and DOE an annual summary status report and assessment of these activities, including the effect of codes and standards on national competitiveness in hydrogen energy

In addition to an annual national Hydrogen Safety Summit, the Committee held a regional summit in Houston, TX, in March 2002. The purpose of the regional summit is to obtain regional and local perspectives on hydrogen safety issues. In Houston, the Committee gained the perspective and concerns of key industries, such as petroleum, petrochemicals, and natural gas, as well as those of local and regional governmental agencies and non-governmental organizations.

The major emphasis of the Committee will be to provide a national forum to discuss critical hydrogen safety issues. The focus of the Committee will be on coordinating hydrogen safety in general and not coordinating the development of specific codes and standards, which is the focus of the HCSCC. The Committee will conduct its annual national Hydrogen Safety Summit in conjunction with the fall meeting of the HTAP in October 2002. At the nation Hydrogen Safety Summit, the Committee plans to present and discuss a National Hydrogen Safety Agenda.

Partnership for Advancing the Transition to Hydrogen

In addition to sponsoring activities related to ISO TC197 and other international standards development organizations, the DOE is also sponsoring efforts to coordinate codes and standards activities among key countries outside of the European Union. 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.

As one step in this process of strengthening international interests in hydrogen energy, the DOE is co-sponsoring the creation of a "regional" hydrogen association to improve knowledge about hydrogen while strengthening hydrogen organizations in interested countries. The Program is helping to organize the Partnership for Advancing the Transition to Hydrogen (PATH) to link and unify hydrogen interests of, to date, Canada, Japan, Argentina, and the U.S.

The goals of the 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. The 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.

To date, introductory and exploratory meetings have been held in Paris and in Tokyo in conjunction with other hydrogen meetings. Commitments to join the PATH have been made by Canada, Japan, and the U.S. Articles of incorporation and by-laws to govern the PATH have been drafted and are under review by prospective members. An organizational meeting was held at the World Hydrogen Energy Conference (WHEC) in Montreal in June 2002. The DOE is funding the administrative costs for at least the first year of the PATH and providing technical support as well.

Outreach

Outreach involving public education and information dissemination on hydrogen safety and codes and standards is another key component of the DOE hydrogen effort. As a continuing part of its coordination effort, the DOE is providing support to the NHA to publish a monthly electronic newsletter for hydrogen codes and standards. The newsletter will provide a central source of information on hydrogen codes and standards activities and issues for the U.S. hydrogen community. The newsletter will also provide a central point where all interested parties can post information for better coordination of codes and standards activities and to improve information transfer on hydrogen safety issues.

In June 2000, Hydrogen 2000 premiered its video, *Hydrogen: The Matter of Safety*, sponsored in part by the DOE, at the Canadian Hydrogen Association meeting in Quebec. This video has been used by corporations and organizations around the world to educate community groups, elected officials, local permitting officials, and insurers about the unique properties of hydrogen and to address common misconceptions about its safety. The California Fuel Cell Partnership obtained 100 copies for its members and for further distribution. Five thousand copies of the video were distributed to attendees at the annual conventions of code and safety organizations, such as the International Code Council, and to other key stakeholders. This year, the DOE is sponsoring, with others, a follow-on video to be produced by Hydrogen 2000. The video, *Hydrogen Energy: The Safe and Clean Alternative*, will be targeted at the general public and was premiered at the WHEC.

The Hydrogen Program is also sponsoring outreach efforts to the building and fire code officials. For example, in October 2001 the Program sponsored a seminar on hydrogen at the annual conference of the SCCI and ICBO in Greenville, NC. The purpose of the seminar was to provide information on hydrogen, fuel cells, and the ICC/AHC effort to interested attendees at the conference. The Program is also sponsoring development of a seminar on hydrogen to be presented in conjunction with NFPA training and education seminars. There is also additional collaborative work planned with NFPA to prepare and distribute a handbook for local fire code officials on permitting hydrogen facilities.

Conclusion

The 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 Program 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.