

IX.1 National Codes and Standards Template

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- Russell Hewett, Leland, NC
- Steele Consulting, Cypress, CA
- Bethlehem Hydrogen, Emmaus, PA
- FP2 Fire Protection Engineering, Golden, CO
- University of South Carolina Research Foundation, Columbia, SC
- Hawaii Natural Energy Institute at the University of Hawaii, Honolulu, HI
- Smart Chemistry, Sacramento, CA
- Sloane Solutions, Oxford, MI
- CSA Standards, Cleveland, OH
- MorEvents, Englewood, CO
- GWS Solutions, Tolland, CT

Project Start Date: 1995
Project End Date: Project continuation and direction determined annually by DOE

- (A) Limited Government Influence on Model Codes
- (B) Competition among SDOs and CDOs (Standards Development Organizations, Code Development Organizations)
- (C) Limited State Funds for New Codes
- (D) Large Number of Local Government Jurisdictions (approximately 44,000).
- (E) Lack of Consistency in Training of Officials
- (F) Limited DOE Role in the Development of International Standards
- (G) Inadequate Representation at International Forums
- (H) International Competitiveness
- (I) Conflicts between Domestic and International Standards
- (J) Lack of National Consensus on Codes and Standards
- (K) Lack of Sustained Domestic Industry Support at International Technical Committees
- (L) Competition in Sales of Published Standards
- (N) Insufficient Technical Data to Revise Standards
- (O) Affordable Insurance is Not Available
- (P) Large Footprint Requirements for Hydrogen Refueling Stations
- (Q) Parking and Other Access Restrictions

Contribution to Achievement of DOE Safety, Codes & Standards Milestones

This project will contribute to achievement of the following DOE milestones from the Hydrogen Codes and Standards section of the Fuel Cell Technologies Program Multi-Year Research, Development and Demonstration Plan:

3	Complete detailed scenario analysis risk assessments. (4Q, 2007)
4	Complete analytical experiments and data collection for hydrogen release scenarios as needed to support code development (Phase 1). (2Q, 2008)
5	Complete model of unintended release in complex metal hydrides. (2Q, 2008)
6	Materials compatibility technical reference updated. (2Q, 2009)
9	Collaborate with ICC and NFPA to develop first- order continuing education for code officials. (4Q, 2005)

Objectives

- Conduct research and development (R&D) needed to establish sound technical requirements for hydrogen and fuel cell codes and standards.
- Support code development for the safe use of hydrogen and fuel cell technologies.
- Advance safety, code development, and market transformation issues through collaborations with appropriate stakeholders.
- Facilitate the safe deployment of hydrogen and fuel cell fuel technologies.

Technical Barriers

This project addresses the following technical barriers from the Hydrogen Codes and Standards section of the Fuel Cell Technologies Program Multi-Year Research, Development and Demonstration Plan:

11	Coordination Committee for hydrogen technical experts to support the code development process established. (4Q, 2003)
12	Draft standards for dispensing systems (dispenser, hoses, hose assemblies, temperature compensating devices, breakaway devices, etc.) completed (CSA America). (4Q, 2005)
15	Draft standards for vehicular fuel systems completed (NFPA). (3Q, 2006)
17	Templates of commercially viable footprints for fueling stations that incorporate advanced technologies developed. (3Q, 2007)
18	Implement research program to support new technical committees for the key standards including fueling interface, and fuel storage. (4Q, 2007)
19	Final draft standards completed for transportable composite containers for balloting (ASME). (1Q, 2008)
20	Draft standards for hydrogen detectors in stationary applications (UL). (4Q, 2008)
21	Completion of necessary codes and standards needed for the early commercialization and market entry of hydrogen energy technologies. (4Q, 2012)
23	Mechanism to support appropriate U.S. Technical Advisory Groups (TAG) in place. (3Q, 2003)
25	Draft regulation for comprehensive hydrogen fuel cell vehicle requirements as a GTR approved (UN Global Technical Regulation). (4Q, 2010)
26	Revised (SAE/ISO) hydrogen quality guidelines adopted. (4Q, 2010)

Accomplishments

NREL has accomplished the following in support of section 3.7 of the DOE Fuel Cell Technologies Program Multi-Year Research, Development and Demonstration Plan:

- Vehicle codes and standards gap analysis: performed an analysis of codes and standards for all six alternative fuel vehicle fuels. The analysis gave background information on the history of fuel usage, the existing codes and standards structure, gaps in the existing codes and standards structure, and research projects or other work needed to fill these codes and standards gaps. This report was published as a NREL technical report in Fiscal Year (FY) 2010.
- Stationary Fuel Cell codes and standards gap analysis: performed an analysis of codes and standards for all stationary fuel cells that are being installed in commercial applications. The analysis gave background information on the history of fuel cells, the existing codes and standards structure, gaps in the existing codes and standards structure, and research projects or other work needed to fill

these codes and standards gaps. This report will be published as a NREL technical report in FY 2010.

- Chemical sensor testing and validation: continued collaborations with key stakeholders; completed formal agreement with the European Commission's Joint Research Centre (JRC) laboratory for testing hydrogen safety sensors and began round-robin testing with the JRC; continued testing commercially available sensors; participated on International Organization for Standardization (ISO) TC197 WG13 to develop a hydrogen sensor standard.
- Component testing: conducted validation testing of high-pressure release devices (HPRD). This work has been used to develop a HPRD standard by CSA America and will be complete in FY 2010. Also initiated compressed natural gas nozzle failure project, which could give useful information on designing hydrogen nozzles.
- Fuel quality specification: worked with ISO on technical specification 14687-2; coordinated testing and modeling to understand the effects of contaminants on fuel cell performance. Continued to support the promulgation of ASTM standards required to test contaminants to show compliance with the ISO standard.
- Codes and standards development: worked with CDOs and SDOs to develop codes, identify gaps, and provide R&D support; participated on National Hydrogen and Fuel Cell Codes and Standards Coordinating Committee, DOE Codes and Standards Technical Team, and Hydrogen Industry Panel on Codes; added significant subcontracting responsibilities to support individuals and organizations responsible for codes and standards development.



Introduction

It is essential to develop and promulgate codes and standards in order to provide for the safe use of hydrogen and fuel cell technologies. With the help of key stakeholders, the DOE Fuel Cell Technologies Program and NREL are coordinating a collaborative national effort to prepare, review, and promulgate codes and standards for all hydrogen and fuel cell technologies.

Approach

The Fuel Cell Technologies Program recognizes that domestic and international codes and standards must be established to enable the timely commercialization and safe use of hydrogen and fuel cell technologies. The lack of codes and standards applicable to hydrogen and fuel cell technologies is an institutional barrier to deploying

these technologies. It is in the national interest to eliminate this potential barrier. As such, the Hydrogen Codes and Standards sub-program works with domestic and international SDOs to facilitate the development of performance-based and prescriptive codes and standards. These standards are then referenced by building and other codes to expedite regulatory approval of hydrogen and fuel cell technologies. This approach ensures that U.S. consumers can purchase products that are safe and reliable, regardless of their country of origin, and that U.S. companies can compete internationally.

Results

The Safety Codes and Standards work is divided into three major areas:

1. National Template Implementation
2. Codes and Standards Research
3. Codes and Standards Training and Outreach

This report addresses the National Template

National Template Implementation

National Template Implementation, shows both the hierarchy for enforcing codes and standards and some of the progress made in promulgating the codes and standards required to implement hydrogen and fuel cell technologies (Figure 1).

In FY 2010 good progress was made in this implementation effort. National Fire Protection Association (NFPA) 2 Hydrogen Technologies Code was published as a Report on Proposal draft and the Hydrogen Technology Technical Committee met at NREL to act on comments to the draft. A final document will be issued in either December 2010 or July 2011 depending on whether there are any challenges to

the document. NREL has supported the development of NFPA 2 in several ways including:

- Acting as a principal member of the technical committee.
- Funding subcontractors actively participating in the development of the document such as FP2 Fire Protection Engineering.
- Hosting meetings.

Another key codes and standards development area is the development of hydrogen fueling station component and system standards being performed by Canadian Standards Association (CSA) Standards. These H-4 series of documents consists of nine component standards and one system standard that address hydrogen dispensing. An NREL subcontractor is participating as a member of the CSA technical committee drafting these documents.

NREL continues to support the National Hydrogen and Fuel Cell Codes and Standards Coordinating Committee. This effort, which is coordinated and directed by NREL, holds monthly meeting where SDOs, DOE laboratories, industry representatives, DOE and other interested parties are given topical information on codes and standards development activities.

Conclusions and Future Directions

NREL will continue to support the development of codes and standards by:

- Working with DOE to implement a national template for vehicle codes and standards development.
- Continuing R&D support of the key technologies required to close the gaps identified in the codes and standards development process.

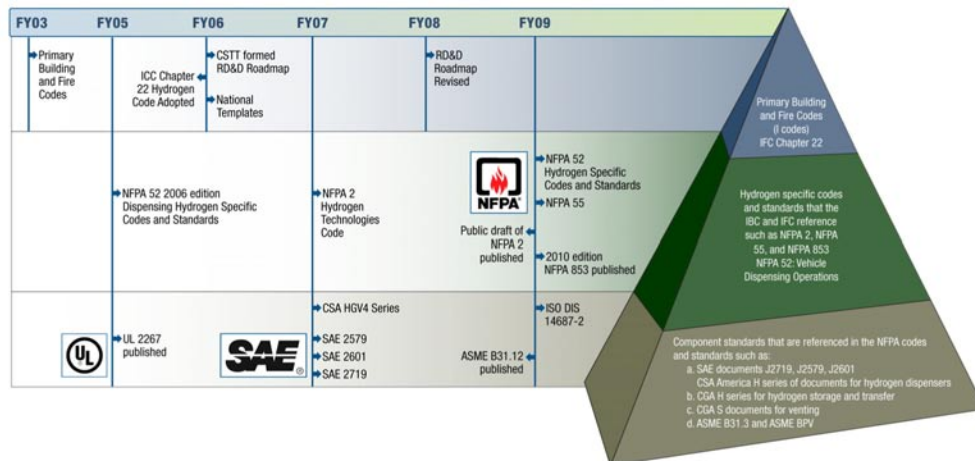


FIGURE 1. Hierarchy of Codes and Standards Implementation

- Continuing R&D collaborations with national and international stakeholders on vehicle codes and standards activities.
 - Performing outreach work to distribute information on hydrogen and fuel cell technologies to code officials, project developers, and other interested parties.
 - Coordinating domestic codes and standards and international standards to ensure consistent requirements.
4. Hydrogen Storage, Transportation, Handling, and Distribution: Section 13- Hydrogen Safety Codes and Standards, Blake, C. and Rivkin, C. CRC Press 2010.
 5. US Department of Energy Support for Codes and Standards Development, Rivkin, C. University of Ulster Belfast, UK Short Course on Hydrogen Safety June 14, 2010.
 6. NREL Hydrogen Component Projects Rivkin, C. University of Ulster Belfast, UK Short Course on Hydrogen Safety June 15, 2010.
 7. Round Robin Testing of Commercial Hydrogen Sensor Performance- Observation and Results, Buttner, W., Burgess, R., Rivkin, C., Post, M., Boon-Brett, L, Black, G., Harskamp, F., Moretto, P. published in the proceedings of the National Hydrogen Association 2010 Annual Conference.
 8. High pressure Hydrogen Storage; Validation Testing of SAE performance Based System Level Requirements, Burgess, R. published in the proceedings of the National Hydrogen Association 2010 Annual Conference.

FY 2010 Publications/Presentations

1. Vehicle Codes and Standards: Overview and Gap Analysis, Blake, C., Buttner, W., Rivkin, C. 2010 NREL technical report TP-560-47336.
2. A National Set of Hydrogen Codes and Standards for the US, Rivkin, C., Blake, C., Burgess, R., Buttner, W., Post, M. 2010 published in the International Journal of Hydrogen Energy.
3. An Overview of Hydrogen Safety Sensors, Butter, W., Blake, C., Burgess, R., Post, Rivkin, C., 2010 published in the International Journal of Hydrogen Energy.