

VIII.6 National Codes and Standards Coordination

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Subcontractors:

- CSA, Standards, Cleveland, OH
- FP2 Fire Protection Engineering, Golden, CO
- GWS Solutions, Tolland, CT
- Kelvin Hecht, Avon, CT
- MorEvents, Englewood, CO
- SAE International (SAE), Warrendale, PA
- Sloane Solutions, Oxford, MI
- Steele Consulting, Cypress, CA

Project Start Date: 1995

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

Fiscal Year (FY) 2012 Objectives

- Support the safe deployment of hydrogen and fuel cell technologies.
- Identify the codes and standards required to deploy hydrogen and fuel cell technologies.
- Identify the research and validation testing required to support the development of the needed codes and standards.
- Advance hydrogen and fuel cell technologies safety, code development, and technology deployment through collaborations with appropriate stakeholders.

Technical Barriers

This project addresses the following technical barriers from the Safety, Codes and Standards section (3.7) of the Fuel Cell Technologies Program's Multi-Year Research, Development and Demonstration Plan:

- A. **Limited Government Influence on Model Codes**
The code development process is voluntary, so the government can affect its progression, but ultimately it is up to the CDOs.

B. **Competition among standards development organizations (SDOs) and code development organizations (CDOs)**

The competition between various organizations may hinder the creation of consistent vehicle codes and standards.

D. **Large Number of Local Government Jurisdictions (approximately 44,000)**

The large number of jurisdictions hinders the universal adoption of codes and standards.

E. **Lack of Consistency in Training of Officials**

The training of code officials is not mandated and varies significantly. The large number of jurisdictions leads to variation in training facilities and requirements.

F. **Limited DOE Role in the Development of International Standards**

Governments can participate and influence the development of codes and standards, but they cannot direct the development of international standards.

G. **Inadequate Representation at International Forums**

Participation in international forums and meetings is voluntary and, to date has been limited by budgetary constraints.

H. **International Competitiveness**

Economic competition complicates the development of international standards.

I. **Conflicts between Domestic and International Standards**

National positions can complicate the harmonization of domestic and international standards.

J. **Lack of National Consensus on Codes and Standards**
Competitive issues hinder consensus.

K. **Lack of Sustained Domestic Industry Support at International Technical Committees**

Cost, time and availability of domestic experts have limited consistent support of the activities conducted within the international technical committees.

Q. **Parking and Other Access Restrictions**

Complete access to parking, tunnels and other travel areas has not yet been secured. Appropriate Codes and Standards need to be developed to provide safe access to these areas.

Technical Targets

The set of key tasks shown below are taken from the draft Safety, Codes and Standards Multi-Year Plan.

The tasks shown are supported by the work done in the NREL coordination task, with a major focus on the National Codes and Standards Chronological Development Plan

(which includes several other tasks) and the fueling station codes template. Both of these activities will be complete by the planned dates.

Task 4: Development and Harmonization of Regulations, Codes and Standards
Identify and evaluate failure modes. (3Q, 2013)
Develop supporting research programs (round robins) to provide data and technologies. (2Q, 2012)
Complete determination of safe refueling protocols for high pressure systems. (1Q, 2012)
Complete risk mitigation analysis for advanced transportation infrastructure systems. (1Q, 2015)
Revision of National Fire Protection Association (NFPA) 2 to incorporate advanced fueling and storage systems and specific requirements for infrastructure elements such as garages and vehicle maintenance facilities. (3Q, 2016)
Complete National Codes and Standards Chronological Development Plan. (4Q, 2014)
Complete fueling station codes and template. (4Q, 2014)
Completion of standards for critical infrastructure components and systems. (4Q, 2014)
Completion of Global Technical Regulation Phase 2. (1Q, 2017)

Table 1 shows the NREL support for achieving DOE technical targets, specifically supporting the development of the codes and standards required to deploy hydrogen and fuel cell technologies. This technical target is described on page 3.7-1 and 2 of the Codes and Standards –Technical Plan.

FY 2012 Accomplishments

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

- NREL has produced the DOE 2020 Codes and Standards Plan for the Deployment of Hydrogen Fuel Cell Vehicles. This plan (the 2020 Plan) defines the codes and standard work required for commercial deployment of hydrogen fuel cell vehicles by 2020.
- NREL supported the development of NFPA 2 Hydrogen Technologies Code that was published as a final document January 2011. NREL staff acted as a principal member of the NFPA Hydrogen Technology Technical Committee and acted as task group leader with the planning task group that will produce the 2014 edition *NFPA 2 Hydrogen Technologies Code*.
- Sensor Laboratory: NREL conducted a Sensor Workshop in June 2011. The final report from the workshop was published in 2012 and it defines sensor needs including the need for auto-calibration to decrease maintenance costs.
- Component testing: Compressed natural gas (CNG) nozzle failure study that was initiated in 2011 was completed in 2012. The report describes potential

problems and solutions to CNG nozzle failures that could be applied to hydrogen nozzles.

- Fuel quality specification: Continued to support the promulgation of ASTM International standards required to test contaminants to show compliance with the ISO standard through funding the production of calibration gases required to verify the ASTM test methods. Additionally, NREL supported the work of Michael Steele, Chairman of the SAE Fuel Cells technical Committee that has produced the final SAE J2719 standard.
- Codes and standards coordination: NREL continued to support the coordination of codes and standards development through software that identified the SDOs and CDOs involved in hydrogen and fuel cell technologies codes and standards development. NREL has updated this software to include current project information. This software is shown in Figure 2.
- Subcontract Management: NREL assumed responsibility for several additional subcontracts. NREL staff developed new statements of work for these subcontracts that reflected DOE priorities and budget constraints. NREL has in 2012 developed subcontract tracking process that shows the progress made under each subcontract and the funding status.



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 (FCT) 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 FCT 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 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

TABLE 1. Progress towards Meeting Technical Targets for Safety Codes and Standards

DOE Accomplishments in Support of the Development of Regulations, Codes and Standards for the Deployment of Hydrogen and Fuel Cell Technologies			
Regulation, Code, or Standard	NREL Support	Status	Time Saved Producing Document (resulting from DOE support)
1. Global Technical Regulation (GTR) for fuel cell vehicles	Tank testing data, SAE International standard that provided basis for document, expert technical support from Dr. Sloane and Glenn Scheffler	Phase 1 work complete in 2011	5 years
2. NFPA 2 Hydrogen Technologies Code 2011 edition	Extensive technical analysis to develop Risk informed requirements for siting hydrogen storage systems. Extensive logistical support including support committee chair and consultant producing draft code document	Final document promulgated 2011	3 years
NFPA 2 Hydrogen Technologies Code 2014 edition	Extensive support of NFPA 2 task groups including task groups that address fueling and vehicle infrastructure	Final document to be issued 2014	1 year
3. International Fire Code (IFC) Section 2209 Hydrogen Motor-Fuel Dispensing and Generation Facilities	Supported Hydrogen Ad Hoc Working Group that wrote section 2209	Final document promulgated 2003	6 years
4. SAE J2579 Technical Information Report for Fuel Systems in Fuel Cell and Other Hydrogen Vehicles The Fuel Cell Standards Committee has the next edition of J2579 listed as a Work in Progress	Performed validation testing through subcontractor. Provided logistical support for SAE Fuel Cell Technical Committee NREL supports this project through committee participation	Technical Information Report published 2009	3 years
5. SAE J2601 Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles The Fuel Cell Standards Committee is actively working on revising this document to incorporate the latest information vehicle fueling protocols	Performed validation testing for fueling algorithm in standard. Provided logistical support for SAE Fuel Cell Standards Technical Committee NREL supports this project through committee participation	Standard published 2010	3 years
6. International Organization for Standardization (ISO) 14687 Hydrogen fuel -- Product specification -- Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles/SAE J2719 Development of a Hydrogen Quality Guideline for Fuel Cell Vehicles	Extensive test data, logistical support, and coordination of ISO/SAE standard development activities.	SAE J2719 issued as final document in 2011 and ISO 14687 achieved final vote stage in 2011.	5 years
7. CSA Standards H series of component standards for hydrogen dispensing operations and onboard vehicle safety	Extensive logistical support as well as validation testing of Hydrogen pressure relief device standard		6 years
8. ASME B31.12 Hydrogen Piping and Pipelines	Provided test data and logistical support.	Final document 2008	3 years
9. Compressed Gas Association Hydrogen Documents including G-5 through G5-8	Provided logistical support	Documents issued 2004 through 2007	3 years

origin, and that U.S. companies can compete internationally by having coordinated consistent requirements.

Results

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

- Codes and Standards Coordination
- Codes and Standards Research
- Codes and Standards Training and Outreach

This report addresses the Codes and Standards Coordination work.

Codes and Standards Coordination

Figure 1, Hierarchy of Codes and Standards 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 2 shows the front page of the coordinating software NREL has developed to track codes and standards development activities.

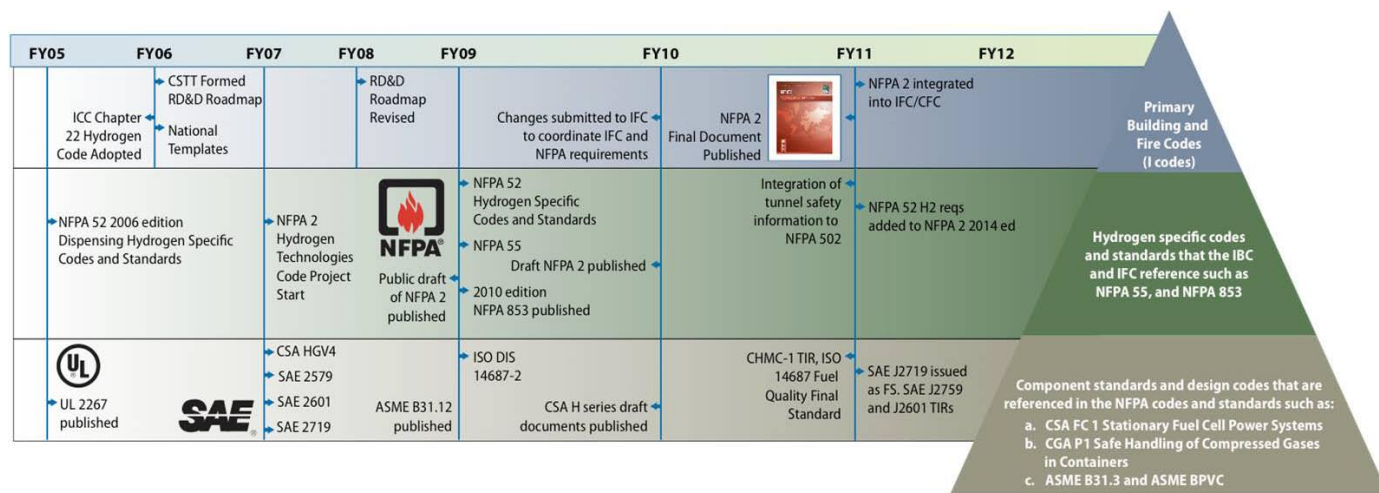


FIGURE 1. Hierarchy of Codes and Standards Implementation

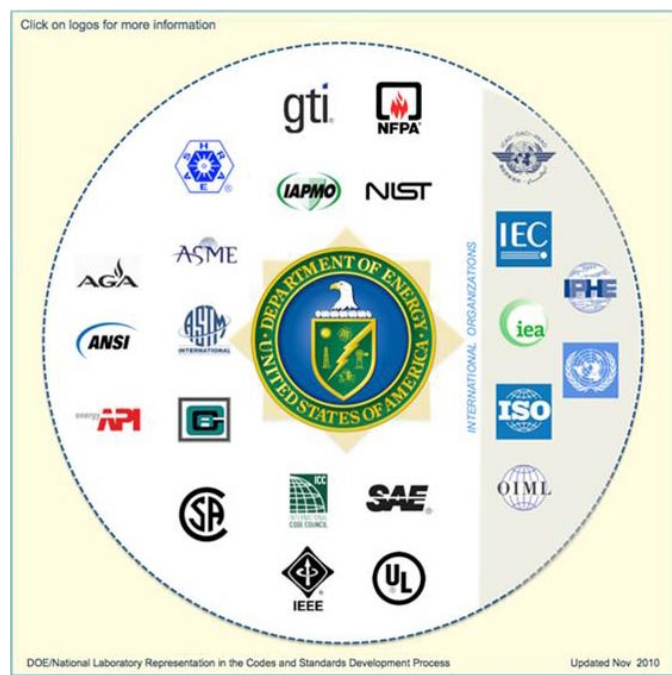


FIGURE 2. NREL Codes and Standards Coordinating Software

In FY 2012 good progress was made in this implementation effort. NFPA 2 Hydrogen Technologies Code was published as final document in January 2011. NREL is working on coordinating the requirements of NFPA 2 with the hydrogen requirements in the IFC through a proposal to reference NFPA 2 in the 2015 edition of the IFC. NREL supported the development of NFPA 2 in several ways including:

- Principal membership of the technical committee
- Funding subcontractors actively participating in the development of the document such as FP2 Fire Protection Engineering

- Reviewed status of key infrastructure that could restrict the deployment of hydrogen fuel cell vehicles such as tunnels and public parking garages

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 staff member participated as a member of the CSA technical committee drafting these documents. Several of these standards were issued as final documents in 2012.

NREL supported the Fuel Cell and Hydrogen Energy Codes and Standards Coordinating Committee. This effort, which is coordinated and directed by NREL, held monthly meetings where SDOs, DOE laboratories, industry representatives, DOE and other interested parties are given topical information on codes and standards development activities. In the first quarter of 2012 NREL ran and administered all aspects of this task.

NREL also supported the Hydrogen Industry Panel on Codes which has as its primary objective the coordination of hydrogen safety requirements in the IFC and other key International Code Council codes such as the International Building Code and the NFPA hydrogen safety requirements that reside primarily in NFPA 2. In May 2012 Hydrogen Industry Panel on Codes successfully concluded their key work in coordinating the IFC and NFPA codes. They voted to end the Hydrogen Industry Panel on Codes organization. This action reflects the progress made in hydrogen technologies code development.

NREL supported both the development of fuel quality standards through acquiring test data and coordinating the activities of the ISO Technical Committee 197 and the SAE

Fuel Cell Technical Committee. These efforts resulted in the promulgation of SAE J2719 Hydrogen Fuel Quality for Fuel Cell Vehicles.

Conclusions and Future Direction

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

- Working with DOE to implement a plan for identifying and supporting the development of the codes and standards required to deploy hydrogen and fuel cell technologies with a particular emphasis on road vehicles by the year 2020 (the 2020 Deployment Plan).
- Continuing research and development at the NREL Sensor Laboratory to support the development of sensors required to deploy hydrogen and fuel cell technologies.
- Developing a plan to address hydrogen dispensing component safety issues, performing work to address these issues, and making codes and standards proposals to address any codes and standards issues associated with component safety.

- Managing subcontracts required to support the 2020 Deployment Plan.
- 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.

FY 2012 Publications/Presentations

1. Codes and Standards Requirements for Deployment of Emerging Fuel Cell Technologies. R. Burgess, W. Buttner, C. Rivkin 2011. NREL Technical Report TP-5600-52641.