

## IX.3 Codes and Standards Training and Outreach and Education for Emerging Fuel Cell Technologies

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- SAE International (SAE), Warrendale, PA
- 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

### 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:

- (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)

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:

- Codes and standards workshops: expanded codes and standards workshops from Fiscal Year (FY) 2009 to cover more subject matter, including a new module on electric vehicles and infrastructure requirements for electric vehicles. Presented four workshops in FY 2010 partnering with local fire departments and government organizations.
- Web-based information compendium: expanded compendium to include other vehicle fuels and to include updated code official training course that includes material on indoor hydrogen fueling.



## 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 subprogram 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 will address codes and standards outreach.

## Codes and Standards Training and Outreach

NREL has several active training and outreach projects in FY 2010 including the following:

- Codes and Standards workshops.
- Update of code official on-line training course.
- Analysis of two emerging fuel cell technology projects (funded through the Education sub-program).

NREL conducted four Codes and Standards workshops in FY 2010. These workshops were held in Tampa, FL, New Orleans, LA, San Francisco, CA and Los Angeles, CA. All four were held in collaboration with local fire service departments or organizations. These workshops were targeted at code officials and project developers who would be working on fuel cell or hydrogen technology projects.

The proceedings from these workshops are posted at the Hydrogen Program Safety, Codes and Standards Web page. Generally, the workshops have been effective at getting information to individuals who will be directly involved in hydrogen and fuel cell projects. These individual proceedings include plan reviews for officials of fire departments and project managers responsible for getting hydrogen and fuel cell projects built.

The Code Official training course that was placed on-line in FY 2009 was amended to include material on indoor fueling operations. Indoor fueling is a special concern because of the developing use of hydrogen-fueled forklifts that are typically fueled indoors.

Another key project is two case studies that address emerging fuel cell technologies. The first project is an evaluation of codes and standards and safety issues associated with a fuel cell system used to supply backup power at a military base and the second is an evaluation of indoor fueling and forklift operations at a military

storage facility. The analysis and findings from these projects will be published as an NREL technical report that would assist code officials and project developers in codes and standards and safety evaluations in similar projects.

Figure 1 shows the how the work done in the outreach activities feeds into the research projects and codes and standards development work.

### 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.

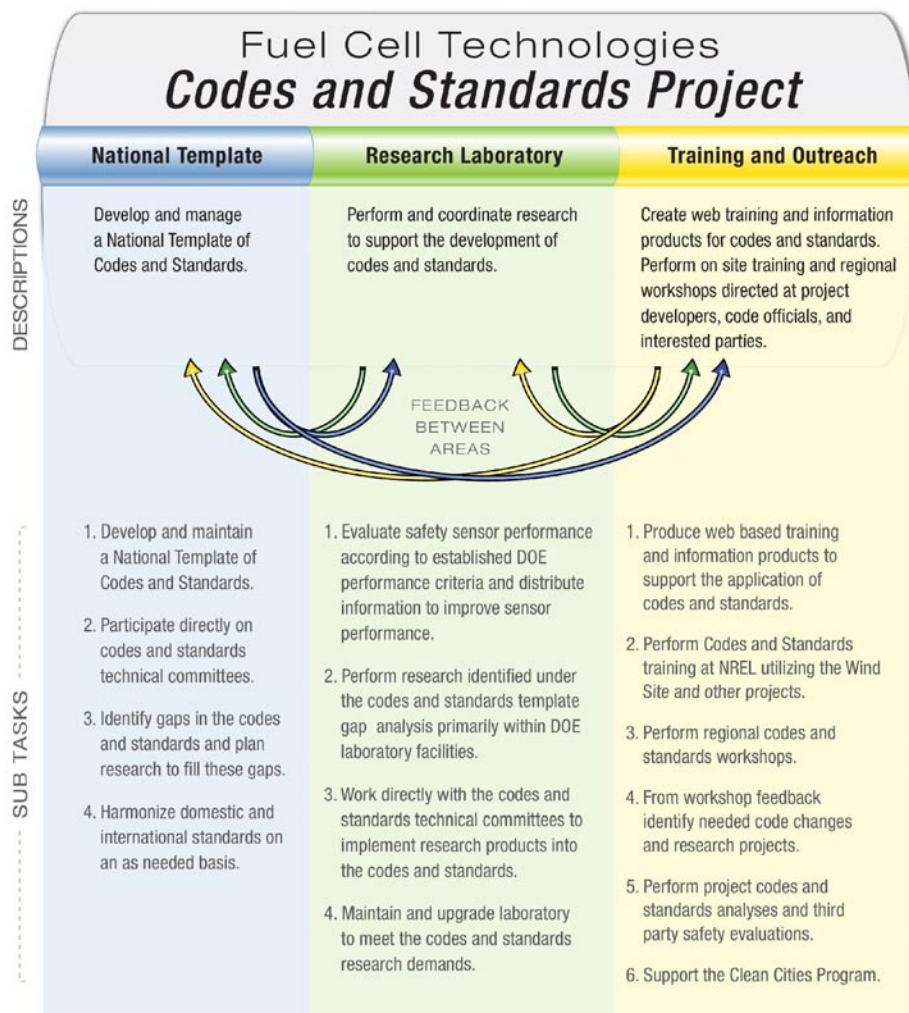


FIGURE 1. Structure of Safety, Codes and Standards Work at NREL

- 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.