

## VIII.7 Fuel Cell Technologies National Codes and Standards Development and Outreach

Carl Rivkin (Primary Contact), Robert Burgess, and William Buttner

National Renewable Energy Laboratory (NREL)  
15301 Denver Parkway West  
Golden, CO 80401  
Phone: (303) 275-3839  
Email: Carl.Rivkin@nrel.gov

DOE Manager

Will James  
Phone: (202) 287-6223  
Email: Charles.James@ee.doe.gov

Subcontractor

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Technologies Code by leading the NFPA Hydrogen Storage Task Group and acting as Principal Committee member of the NFPA Industrial and Medical Gas Technical Committee

- Develop outreach products for permitting hydrogen technologies
- Publish updated National Permit Guide for hydrogen fueling stations
- Present codes and standards information at California hydrogen technologies deployment meetings and workshops
- Implement Continuous Codes and Standards Improvement (CCSI) Process by evaluating field data to determine codes and standards development priorities
- Provide in-person training to code officials and project developers in key jurisdictions in California and other locations where infrastructure projects are planned
- Support the coordination of domestic and international hydrogen standards by participating in International Organization for Standardization (ISO)/TC 197 hydrogen component development projects

### Overall Objectives

- Support the deployment of hydrogen technologies for hydrogen fuel cell vehicles and stationary fuel cell applications
- Make critical safety information readily available through webinars, training sessions, safety reports, and technical presentations
- Inform key stakeholders of the safety, codes, and standards requirements for the safe use of hydrogen technologies
- Work with potential infrastructure developers to accelerate the deployment of hydrogen fueling stations and other key infrastructure
- Identify and resolve safety issues associated with hydrogen technologies infrastructure

### Fiscal Year (FY) 2015 Objectives

- Publish a paper on progress and accomplishments in the development of codes and standards
- Support the deployment efforts of H2USA through participation in the Market Acceleration and Support Working Group
- Support the development of the next edition of the Nation Fire Protection Association (NFPA) 2 Hydrogen

### Technical Barriers

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

- (A) Safety Data and Information: Limited Access and Availability
- (D) Lack of Hydrogen Knowledge by AHJs. (Authorities Having Jurisdiction)
- (F) Enabling National and International Markets Requires Consistent RCS (Regulations, Codes, and Standards)
- (G) Insufficient Technical Data to Revise Standards
- (H) Insufficient Synchronization of National Codes and Standards
- (I) Lack of Consistency in Training of Officials
- (K) No Consistent Codification Plan and Process for Synchronization of R&D and Code Development
- (L) Usage and Access Restrictions

## Contribution to Achievement of DOE Safety, Codes & Standards Milestones

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

- Milestone 4.6: Completion of standards for critical infrastructure components and systems. (4Q, 2014)
- Milestone 4.7: Complete risk mitigation analysis for advanced transportation infrastructure systems. (1Q, 2015)
- Milestone 4.8: Revision of NFPA 2 to incorporate advanced fueling and storage systems and specific requirements for infrastructure elements such as garages and vehicle maintenance facilities. (3Q, 2016)
- Milestone 4.9: Completion of GTR Phase 2. (1Q, 2017)

## FY 2015 Accomplishments

- NREL provided broad coordination of codes and standards development.
  - Supported the Codes and Standards Tech Team; gave three presentations on sensors and codes and standards development activities
  - Implemented the CCSI through several projects
    - Supported the Hydrogen Code Improvement (HCI) team through Fuel Cell & Hydrogen Energy Association codes and standards development activities including support of the H2USA codes and standards development efforts
    - Led the NFPA Hydrogen Storage Task Group to develop technical basis for setback distances and safety mitigation measures in NFPA 55 and NFPA 2
- Coauthored an historical perspective on the history of RCS called “Regulations, Codes and Standards (RCS) for Hydrogen Technologies—A Historical Overview,” a paper that will be presented at the International Conference on Hydrogen Safety (ICHS) in Yokohama, Japan
- Developed new permitting and codes and standards training modules for hydrogen technologies deployment that include lessons learned from current deployment activities
- Developed a training video titled “Permitting Hydrogen Fueling Station” in collaboration with an AHJ in the

Los Angeles metropolitan area where several hydrogen fueling stations will be located

- Presented in-person training sessions for deployment of hydrogen infrastructure in key jurisdictions including Norwalk and Hayward, California; approximately 70 AHJs representing jurisdictions where hydrogen fueling stations will be located attended these training sessions
- Hosted several international researchers in hydrogen safety to leverage similar safety work being conducted in other countries
- Collaborated effectively with other DOE laboratories including Sandia National Laboratories and Pacific Northwest National Laboratory



## INTRODUCTION

The fundamental purpose of this work is to support the safe deployment of hydrogen technologies. To achieve this objective, codes and standards must be in place to protect public safety and any significant safety issues must be resolved.

The work under this project has helped develop a national set of codes and standards to safely deploy hydrogen technologies. Additionally, key safety issues have been identified and are in the process of being resolved. Safety, codes, and standards information has been distributed to interested parties using a variety of techniques including webinars, NREL technical reports, workshops, in-person presentations, videos, online training tools, and web-based products.

## APPROACH

The project approach has been to involve as many key stakeholders as possible in codes and standards development and coordination and outreach activities to achieve maximum effectiveness. These stakeholders include industry partners, standards development organizations, research organizations including other national laboratories, authorities having jurisdiction, local government in locations where projects will be deployed, and trade organizations involved in technology development and deployment.

## RESULTS

NREL, at the direction of DOE, has helped develop a baseline set of codes and standards for hydrogen technologies. This accomplishment helps meet several DOE milestones, including 4.4 and 4.8.

The next step in this codes and standards development process after the promulgation of the baseline set of codes and standards is monitoring the field performance of these documents, determining where modifications are required, and supporting the implementation of those modifications. This helps DOE meet Milestone 4.5.

This modification process is illustrated in Figure 1. The process consists of evaluating field deployment of hydrogen technologies through use of NREL data and site visits, determining whether there are issues with codes and standards based on this information, and developing modified codes and standards requirements to resolve these issues. This process also integrates NREL laboratory research activities involving hydrogen technologies safety by using this research to address codes and standards issues.

The CCSI process has already begun to produce results in the following areas:

- The NFPA Hydrogen Storage Task Group has revisited the assessment made for bulk gaseous hydrogen setback distances and has developed a plan for revising these distances in the 2018 edition of NFPA 55/2. This plan should produce proposals to NFPA 55/2 in July 2016.
- The HCI team has produced proposals to the Uniform Fire Code (UFC) to coordinate NFPA 2 and the UFC.

NREL developed codes and standards/permitting training tools such as the “Permitting Hydrogen Fueling

Stations” video done in collaboration with the Orange County Fire Authority.

NREL supported the work of H2USA by participating as a member of the Market Acceleration and Support Working Group. This participation included evaluating infrastructure issues such as fuel cell electric vehicle access to tunnels and bridges in New York and Maryland.

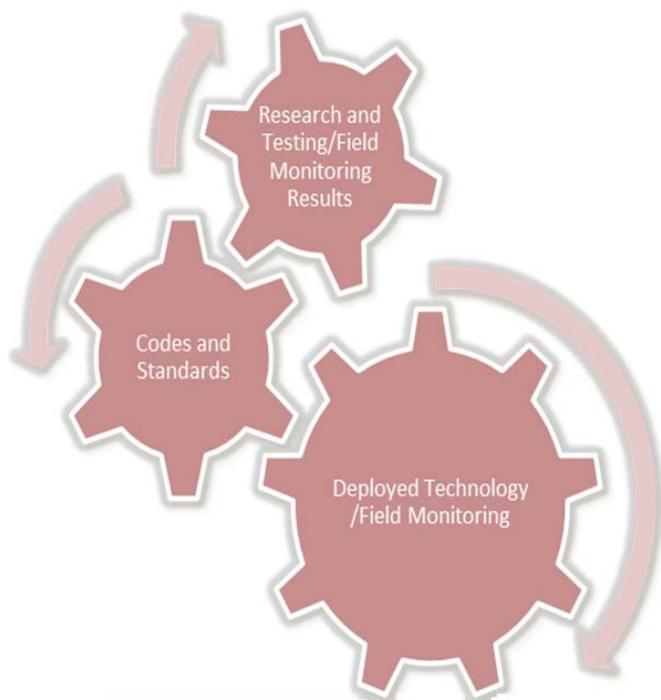
NREL supported testing required to develop Federal Motor Vehicle Safety Standards required to implement Global Technical Regulation (GTR) in the United States. This supports DOE Milestone 4.9.

NREL has acted as Task Group Leader for the NFPA Hydrogen Storage Task Group that will develop new requirements for bulk gaseous and liquefied hydrogen and associated safety mitigation measures for the next edition of NFPA 55/2. This supports DOE Milestone 4.9.

## CONCLUSIONS AND FUTURE DIRECTIONS

### Conclusions

- Codes and Standards
  - Codes and standards development support will continue through direct support of standards development organizations by NREL staff participation on or operation of coordination committees.
  - Ongoing coordination of the fire and building codes and key hydrogen codes and standards is a priority.
  - Field deployment information will help set codes and standards development priorities.
- Outreach
  - Deployment support will be focused on infrastructure at locations with project activity and concrete deployment plans, for example jurisdictions in California.
  - These goals can only be accomplished through collaborations with key stakeholders at all levels.
  - NREL will continue to support deployment of hydrogen and fuel cell technologies through programs such as the technical reports, webinars, safety reviews, and the web-based information compendium.
  - NREL will work with H2 USA to support the efforts of key organizations involved in infrastructure deployment.



**FIGURE 1.** Continuous Codes and Standards Improvement (CCSI)

### Future Directions

- Continue work to coordinate codes and standards on a smaller scale with special focus on taking information from deployment projects back to code development committees
- Resolve infrastructure codes and standards issues such as hydrogen setback distances in NFPA codes
- Continue coordination between National Fire Codes and International Code Council codes, as well as ISO hydrogen component standards and domestic hydrogen component standards
- Support efforts to adopt NFPA 2 Hydrogen Technologies Codes (and other key codes), such as the work done by the California Fire Marshal's Office to adopt NFPA 2 earlier than adoption of the International Fire Code would dictate

### Outreach

- Continue to publish NREL technical reports, deliver webinars, and provide web-based information on key safety issues required to support hydrogen technologies deployment
- Assist code officials, project developers, and other interested parties in use of new codes and standards and safety information through outreach activities, with special focus on key jurisdictions such as California
- Utilize NREL hydrogen fueling station for training purposes
- Work with interested parties to provide information to assist in infrastructure deployment
- Provide in-person codes and standards training in key locations such as California and other zero emission vehicles states
- Work with H2USA to support infrastructure development

### FY 2015 PUBLICATIONS/PRESENTATIONS

1. C. Rivkin "Deployment of Hydrogen Infrastructure," Hayward Fire Department, Hayward, California, December 9, 2014.
2. C. Rivkin, "Deployment of Hydrogen Infrastructure," Los Cerritos Community College, Norwalk, California, August 9, 2015.
3. C. Rivkin, R. Burgess, and W. "Regulations, Codes and Standards (RCS) for Hydrogen Technologies—A Historical Overview," forthcoming, submitted to ICHS, July 2015.
4. C. Rivkin, R. Burgess, and W. Buttner "Continuous Codes and Standards Improvement (CCSI) Overview," forthcoming, submitted to ICHA, July 2015.