VIII.1 Fuel Cell Technologies National Codes and Standards Development and Outreach

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Project Start Date: October 1, 2002
Project End Date: Project continuation and direction determined annually by DOE

Overall Objectives

- Support the deployment of hydrogen technologies for hydrogen fuel cell vehicles, industrial trucks, and stationary fuel cell applications.
- Make critical safety information readily available through webinars, training sessions, safety reports, online training, 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.
- Support the continuous improvement of codes and standards through incorporating research and field data into the code development process.

Fiscal Year (FY) 2016 Objectives

- Publish a paper on the application of the Continuous Codes and Standards Improvement (CCSI) process in developing new risk-based requirements for bulk hydrogen storage.
- Support the deployment efforts through participation in the H2USA's Market Support and Acceleration Working Group.
- Support the development of the next edition of the National Fire Protection Association (NFPA) 2 Hydrogen Technologies Code by chairing the Technical Committee on Hydrogen Technology, leading the NFPA Hydrogen Storage Task Group, and acting as principal committee member of the NFPA Technical Committee on Industrial and Medical Gases.
- Develop outreach products for permitting hydrogen technologies, including an updated National Permitting Guide for Hydrogen Refueling Stations.
- Implement CCSI process by evaluating field data to determine codes and standards development priorities.
- Provide codes and standards information to critical stakeholders such as code officials through in-person training, updated on-line training, and development of relevant videos.
- Support the coordination of international and domestic hydrogen standards by participating in International Organization for Standardization/Technical Committee 197 hydrogen technology projects, hydrogen component development working groups, and domestic standards organizations such as the CSA Group.

Technical Barriers

This project addresses the following technical barriers from the Hydrogen 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

(F) Enabling National and International Markets Requires Consistent RCS

(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 Hydrogen 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 2016 Accomplishments

- NREL provided broad coordination of codes and standards development by:
  - Supporting the Codes and Standards Tech Team; gave three presentations on sensors and codes and standards development activities.
  - Implementing the CCSI through several projects including:
    - Supporting the Hydrogen Code Improvement Team through Fuel Cell & Hydrogen Energy Association codes and standards development activities including support of the H2USA codes and standards development efforts.
    - Leading the NFPA Hydrogen Storage Task Group to develop technical basis for setback distances and safety mitigation measures in NFPA 55 and NFPA 2 and submitting the revised setback distances to the Technical Committee on Industrial and Medical Gases.
- Developed new permitting and codes and standards training modules for hydrogen technologies deployment that includes lessons learned and brings in information from current deployment activities.
- Developed a training video titled “Permitting Hydrogen Fueling Stations” in collaboration with an authority having jurisdiction in the Los Angeles metropolitan area, the Orange County Fire Authority, where several hydrogen fueling stations will be located. This video should reduce the time and cost of both preparing and processing hydrogen fueling station permit applications by quickly orienting people to both the basics of the fueling technology and the code requirements.
- Collaborated effectively with other DOE laboratories, including Sandia National Laboratories and Pacific Northwest National Laboratory, to develop training materials that are available through H2 Tools.

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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 before deployment proceeds.

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 involves as many key stakeholders as possible in codes and standards development and coordination and outreach activities to achieve maximum impact. 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 the deployment of 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 (including the research required to support these modifications), and supporting the implementation of those modifications. Examples of these modifications include the revised setback distances for bulk gaseous hydrogen storage and the development of requirements of fuel cell

electric vehicles in repair garages. 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 2019 edition of NFPA 55/2. This plan produced proposals to NFPA 55/2 that were submitted in June 2016.
- The Hydrogen Code Improvement Team has produced proposals to the Uniform Fire Code to coordinate NFPA 2 and the Uniform Fire Code. Proposals were submitted to coordinate requirements for repair garages in the International Fire Code and NFPA 2.
- The NFPA Enclosures Task Group has developed an extensive set of proposals to the 2019 edition of NFPA 2 to address modular hydrogen fueling stations.

NREL completed codes and standards and permitting training tools such as the "Permitting Hydrogen Fueling Stations" video done in collaboration with the Orange County Fire Authority.

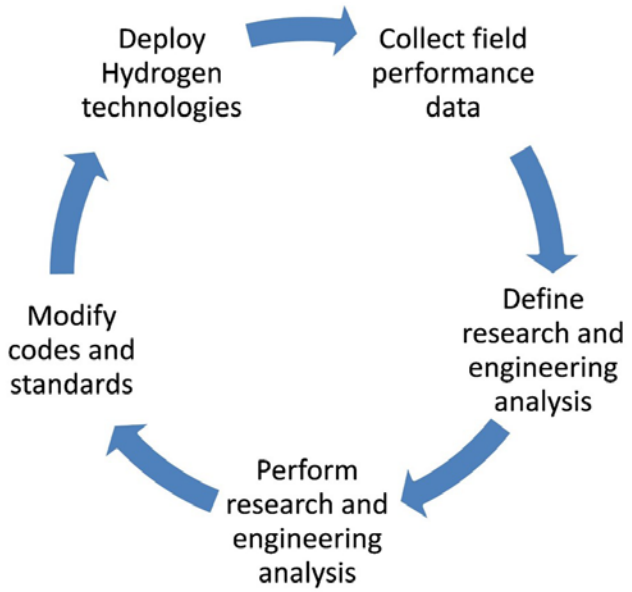

FIGURE 1. CCSI process

NREL supported the work of H2USA by participating as a member of the Market Support and Acceleration Working Group. This participation included presenting information on hydrogen fueling station codes and standards at the 2016 National Association of State Fire Marshals meeting.

NREL supported testing required to develop Federal Motor Vehicle Safety Standards required to implement Global Technical Regulation 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 technical 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 and improve the quality and relevance of codes as this information is incorporated through the American National Standards Institute-proscribed revision process.
- Outreach
  - Deployment support will be focused on infrastructure at locations with project activity and concrete deployment plans, for example jurisdictions in California and the Northeast.
  - 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 technical reports, webinars, safety reviews, and the web-based information compendium. NREL will develop permitting tools that address the different needs of stakeholders and are readily accessible through the internet.

  - NREL will work with H2USA to support the efforts of key organizations involved in infrastructure deployment.

Future Directions

- Continue work to coordinate codes and standards 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 International Organization for Standardization 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's Office of the State Fire Marshal to adopt NFPA 2 earlier than adoption of the International Fire Code would dictate.
- Continue to incorporate research into the codes through the CCSI process.

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 and the Northeast.
- Utilize NREL hydrogen fueling station for training purposes such as videos on hydrogen fueling operations and maintenance.
- 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 vehicle states.
- Work with H2USA to support infrastructure development such as fuel cell electric vehicles using tunnels.

FY 2016 PUBLICATIONS/PRESENTATIONS

1. Rivkin, C., R. Burgess, and W. Buttner. 2016. *Guide to Permitting Hydrogen Motor Fuel Dispensing Facilities*. NREL Report No. TP-5400-64042. Golden, CO: National Renewable Energy Laboratory.

2. Rivkin, C., R. Burgess, and W. Buttner. 2016. "Continuous Codes and Standards Improvement (CCSI)." International Conference on Hydrogen Safety.

3. Rivkin, C., C. San Marchi, and M. Rangachary. 2015. "History of Regulations, Codes and Standards." Presented at 2015 International Conference on Hydrogen Safety, Yokohama, Japan, October 19–21.

4. *Guide for Compliance with Regulations, Codes and Standards for the Deployment of Stationary Fuel Cells*. 2016. Telecommunications Industry Association. (Manuscript under review.)

5. Rivkin, C., C. LaFleur, and M. Gresho. "Siting Bulk Hydrogen Storage Systems: Advances in Risk-Informed Siting Procedures in NFPA Codes." 2016. Presented at AIChE Loss Prevention Symposium, Houston, Texas, April 11–13.