VIII.1 National Codes and Standards Development and Outreach

Carl Rivkin (Primary Contact), Robert Burgess, and William Buttner
National Renewable Energy Laboratory (NREL)
15013 Denver West Parkway
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:
A.V. Tchouvelev & Associates, Inc.,
Mississauga, ON, Canada

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 and associated infrastructure, industrial trucks, and stationary fuel cell applications.
- Integrate safety research into codes and standards.
- 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) 2017 Objectives

- Publish papers on the large scale hydrogen systems and multi-fuel alternative fuel stations.
- 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. Additionally, support NFPA 502 Standard for Road Tunnels, Bridges, and other Limited Access Roadways by incorporating fire safety analysis into document annex.
- Develop outreach products for permitting hydrogen technologies including an updated Code Official Training Course and Guide for Siting Stationary Fuel Cells.
- Implement Continuous Codes and Standard Improvement (CCSI) process by evaluating field data to determine codes and standards development priorities through a NREL technical report on safety research needs.
- Provide codes and standards information to critical stakeholders such as code officials through in-person training, updated on-line training, NREL technical reports posted on DOE websites, and development of relevant videos.
- Support the coordination of international and domestic hydrogen standards such as participating in International Organization for Standardization/Technical Committee 197 hydrogen technologies, 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 2017 Accomplishments

- Created the Inter-Laboratory Research Integration Group (IRIG) to integrate research across the DOE laboratories into NFPA 2 and other hydrogen codes and standards.
  - Submitted key proposals through IRIG to NFPA 2 on adding flexibility to the bulk liquid hydrogen storage requirements, and NFPA 502 on characterizing hydrogen releases in tunnels.
- Lead The NFPA Hydrogen Technologies Technical Committee as committee chair in producing the 2020 edition of NFPA 2 Hydrogen Technologies Code.
  - 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 bulk gaseous setback distances to the Technical Committee on Industrial and Medical Gases and the proposal to add flexibility to siting bulk liquid systems to NFPA 55 and NFPA 2.
- Developed new permitting and codes and standards training tools to support hydrogen technologies deployment, including an updated Code Official Training Course and publishing the Telecommunications Industry Guide to Siting Stationary Fuel Cells.
- Released a training video titled “Permitting Hydrogen Fueling Stations” in collaboration with the Orange County Fire Authority, an authority having jurisdiction (AHJ) with experience permitting several hydrogen fueling stations. 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.

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 primary focus of this project is to identify research needs to support codes and standards development and integrating that research into the appropriate documents.

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 integrating the efforts from 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, AHJs, 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, development of requirements of fuel cell electric vehicles in

repair garages, and material supporting the use of fuel cell electric vehicles in tunnels in NFPA 502. 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 (and other DOE laboratories) 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 submitted proposals to revise the bulk gaseous hydrogen setback distances and provide additional flexibility in siting bulk liquid hydrogen systems in the 2020 edition of NFPA 55/2. This plan produced proposals to NFPA 55/2 that were submitted in June 2016 and in NFPA 2.
- The NFPA Enclosures Task Group has submitted an extensive set of proposals to the 2020 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. As an extension of this permitting support work, NREL introduced the concept of standard permits for hydrogen fueling stations and other infrastructure projects with the intent of developing this concept in FY 2018.

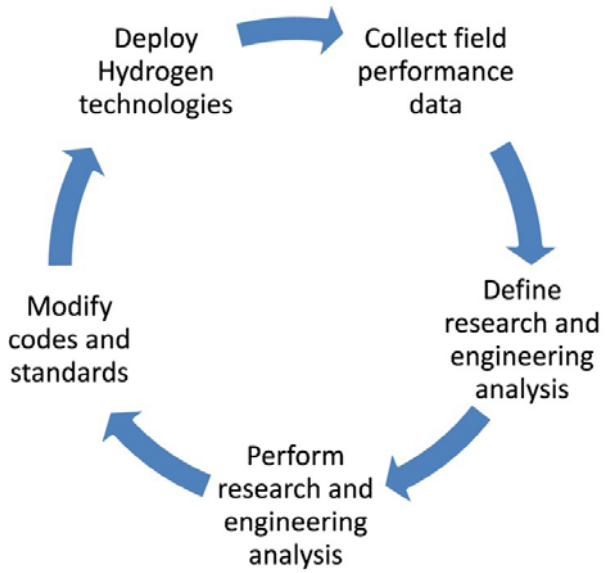

FIGURE 1. CCSI process

NREL supported the work of H2USA by participating as a member of the Market Support and Acceleration Working Group.

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 UPCOMING ACTIVITIES

Conclusions

- Codes and standards
  - The CCSI process is effective at modifying key codes to incorporate research results and define required research, such as characterization of liquid hydrogen releases.
  - Integration of DOE (and other) research into hydrogen codes and standards is a priority to ensure DOE safety research achieves the greatest possible impact on public safety by integration in widely used safety documents.
  - 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
  - Outreach deployment support will be reduced to focus limited resources on IRIG (research integration) efforts.
  - Deployment support focused on infrastructure at locations with project activity and concrete deployment plans, for example jurisdictions in California and the Northeast can be effective at moving projects forward but this is a labor intensive effort.
  - These goals can only be accomplished through collaborations with key stakeholders at all levels.

  - NREL supports the deployment of hydrogen and fuel cell technologies through programs such as technical reports, webinars, safety reviews, and the web-based information compendium. NREL has developed permitting tools that address the different needs of stakeholders and are readily accessible through various DOE websites. These internet accessible tools have provided permitting support for all types of users from the infrequent user to more knowledgeable users.

Upcoming Activities

- Codes and standards
  - NREL will focus on the IRIG project of integrating safety research into codes and standards. Key project areas will be station siting requirements, high-risk component safety, critical infrastructure such as tunnels and garages, and codes and standards streamlining to reflect higher levels of infrastructure deployment.
  - Support H2@Scale work by identifying gaps in safety knowledge and research required to fill these gaps.
  - 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 using the IRIG as the primary mechanism to achieve these incorporations.
  - Support efforts to develop standard permits for hydrogen infrastructure projects to streamline project permitting efforts.
- Outreach
  - Outreach activities will likely be reduced in FY 2018. If they continue work would be performed in the following project areas with a special focus on H2@Scale.
  - 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 or consultation in key locations such as California, New York, Massachusetts, and other zero-emission vehicle states.

FY 2017 PUBLICATIONS/PRESENTATIONS

1. Rivkin, C., R. Burgess, and W. Buttner. 2017. *Regulations Codes and Standards (RCS) for Multi-Fuel Stations.* International Conference for Hydrogen Safety.

2. Rivkin, C., R. Burgess, and W. Buttner. 2017. *Regulations Codes and Standards (RCS) for Large Scale Hydrogen Installations*. International Conference for Hydrogen Safety.

3. *Guide for Compliance with Regulations, Codes and Standards for the Deployment of Stationary Fuel Cells*. 2017. Telecommunications Industry Association.