



2011 DOE Annual Merit Review Fuel Cell Technologies National Codes & Standards Coordination



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Hydrogen Technologies
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NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Overview

T I M E L I N E

- **Start date: October 1, 2002**
- **End date: 10/2011***
- *Project continuation and direction determined annually by DOE *

B A R R I E R S

- **Consensus** - Achieving national agenda on codes & standards (A,B,D,L,J)
- **Representation** – Government & Industry support and DOE limited role (F,G,H,I,K)
- **Technology Readiness** –Jurisdictional issues, related to available codes and existing set back distances (M,N,P)

B U D G E T

- Funding received in FY10:
\$ 0.5M
 - Funding for FY11:
\$ 0.75M*
- * project has added several subcontracts that account for increased funding*

P A R T N E R S

- National H2/Fuel Cells Codes and Standards Coordinating, SDOs, FCHEA, CaFCP, CARB
- FreedomCAR and Fuel Partnership C&S Technical Team

Relevance/Objectives

- Conduct research & development (R&D) needed to establish sound technical requirements for renewable energy codes & standards with a major emphasis on hydrogen and fuel cell technologies.
- Support code development for the safe use of renewable energy in commercial, residential, and transportation applications with a major emphasis on emerging fuel cell technologies.
- Advance renewable energy safety, code development, and market transformation by collaboration with appropriate stakeholders.
- Facilitate the safe deployment of renewable energy technologies

Approach

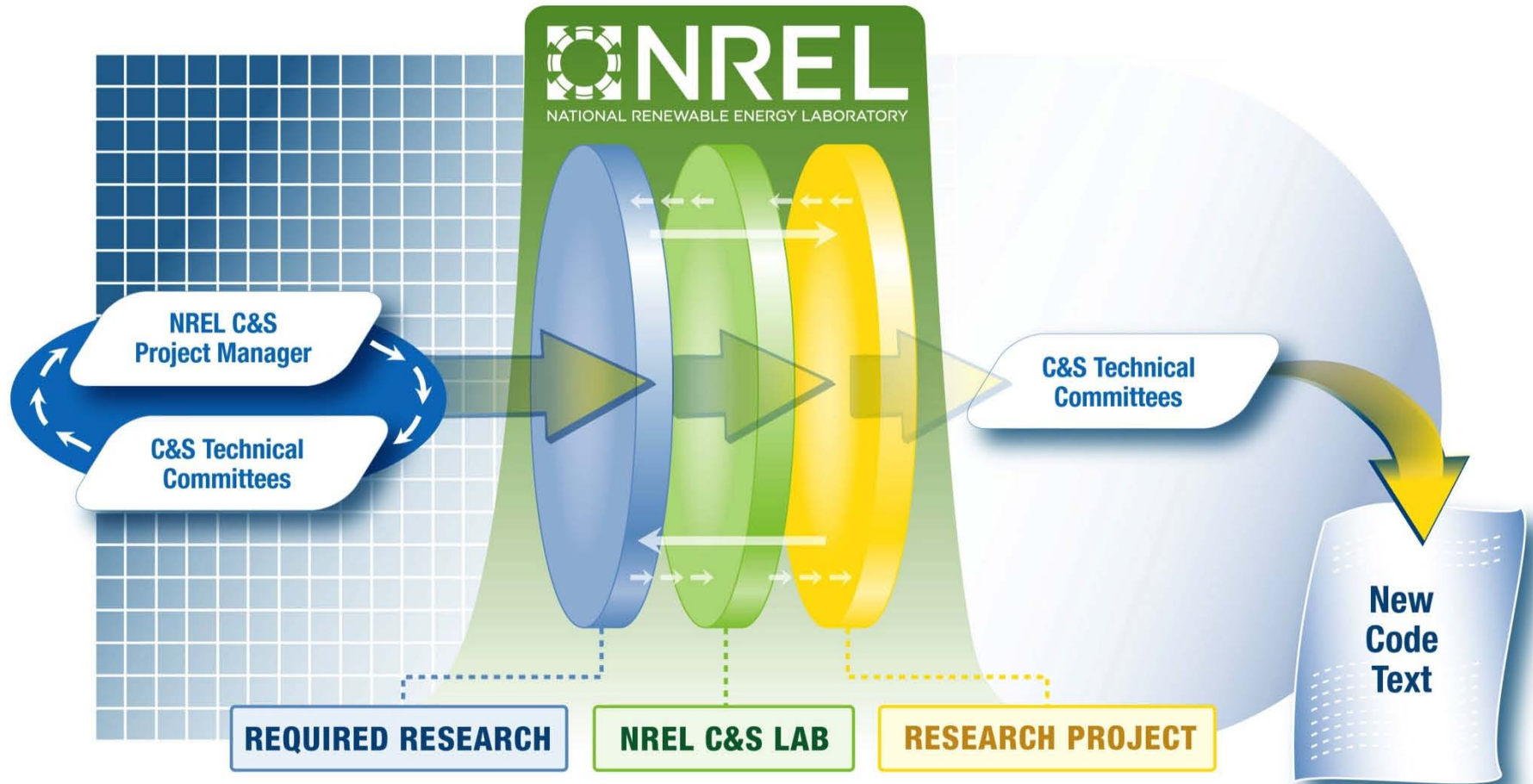
The following approach will ensure that all codes and standards are in place to implement hydrogen and fuel cell technologies:

- **Codes & Standards Coordination and Development**
 - Code Development Support including: SAE, NFPA, CSA Standards, ICC, CGA, ISO, IEC, UL
 - Direct technical committee involvement is key element of approach
 - Coordination Committees: C&S Tech Team, HIPOC, National Codes and Standards Coordinating Committee
- **Collaboration**
 - SNL, LANL, ANL, PNNL, NASA, NIST, JRC, FCHEA, CaFCP, CARB, SDO's, CDO's, Industry
- **Support Technology Readiness/Market Transformation**
 - Permitting workshops and Web based information compendium (discuss in later presentation)

Codes and Standards Project Approach

Fuel Cell Technologies *Codes and Standards Development Process*

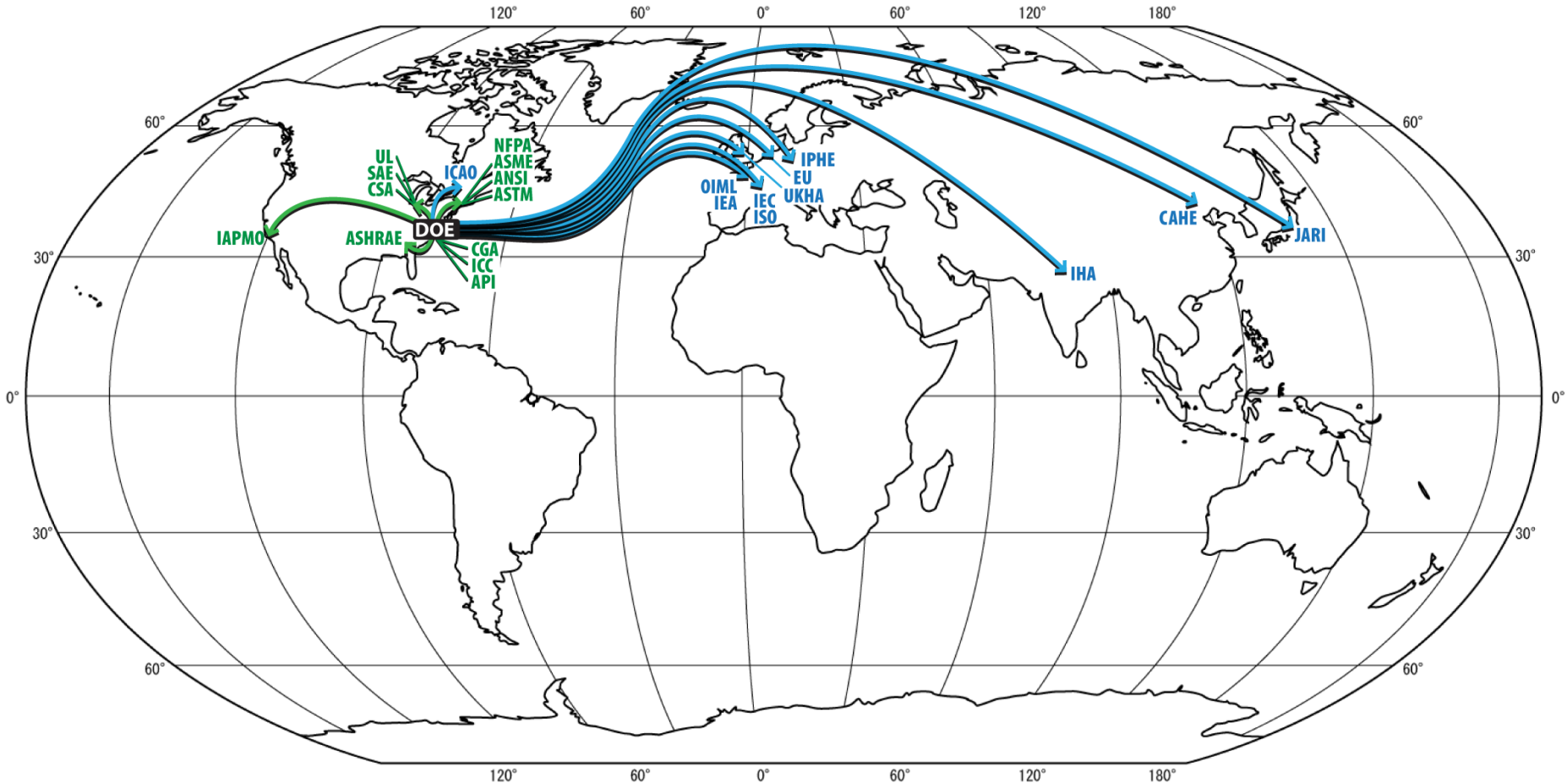
Directed by NREL Codes and Standards Project Manager



Technical Accomplishments

- Used Coordinating Tool to evaluate DOE participation in the Codes & Standards development process and support development of several key projects
- Extensive coordination effort including domestic and international coordination
- Direct support of several Codes & Standards development of projects including:
 - NFPA 2 Hydrogen Technologies Code
 - Fuel quality standard
 - SAE Standards
 - CSA Component standards

Technical Accomplishment— Codes & Standards Development and Coordination



Technical Accomplishment— Codes & Standards Development and Coordination

- Manage codes and standards development directing
 - Supporting CSTT (Codes & Standards Tech Team)
 - Co-chair of National Codes & Standards Coordinating Committee (FCHEA)
 - Work on HIPOC (Hydrogen Industry Panel on Codes)
 - Technical support of Regulatory Logic contracts
 - Directing National Template Implementation
- Direct Participation on Codes & Standards Committees
 - SAE J2579 – Onboard Hydrogen Storage –
 - SAE J2578 – General Fuel Cell Vehicle Safety –
 - NFPA 2 – Hydrogen Technologies Code
 - ISO TS14687-2 – Hydrogen Fuel Quality – coordinate North American team of experts
 - ISO 20100- Hydrogen fuelling stations-serve on technical committee
 - CSA America H4 series of standards

Technical Accomplishment— Comprehensive Coordination of SDOs and CDOs

Organization		Location
ASHRAE	The American Society of Heating, Refrigerating and Air-Conditioning Engineers	Atlanta, GA
ASTM	American Society for Testing and Materials	Philadelphia, PA
ASME	American Society Of Mechanical Engineers	New York City, NY
CGA	Compressed Gas Association	Virginia (suburban DC)
CSA	Canadian Standards Association	Cleveland, OH
ICC	The International Code Council	Virginia (suburban DC)
SAE	Society of Automotive Engineers	Detroit, MI
NFPA	National Fire Protection Association	Boston, MA
IAPMO	The International Association of Plumbing and Mechanical Officials	Los Angeles, CA
UL	Underwriters Laboratory	Chicago, IL
API	American Petroleum Institute	Washington, DC
ANSI	American National Standards Institute	New York City, NY
ISO	International Organization for Standardization	Geneva, Switzerland
EU	European Union	Brussels, Belgium
IEC	International Electrotechnical Commission	Geneva, Switzerland
JARI	Japan Automobile Research institute	Tokyo, Japan
IPHE	International Partnership for Hydrogen Economy	Berlin, Germany
OIML	International Organization of Legal Metrology	Paris, France
IEA	International Energy Agency	Paris, France
ICAO	International Civil Aviation Organization	Montreal, Canada
IHA	Indian Hydrogen Association	New Delhi, India
CAHE	China Association for Hydrogen Energy	Beijing, China
UKHA	United Kingdom Hydrogen Association	Manchester, England

Technical Accomplishment— Codes & Standards Development

- Manage codes and standards development by
 - Supporting CSTT (Codes & Standards Tech Team)
 - Supporting National Hydrogen and Fuel Cells Codes & Standards Coordinating Committee (NHA, USFCC)
 - Supporting HIPOC (Hydrogen Industry Panel on Codes)
 - Providing technical support of Regulatory Logic contracts
 - Promoting National Template Implementation
- Direct Participation on Codes & Standards Committees
 - NFPA 2 Hydrogen Technologies Code
 - UL2267 Fuel cell powered forklifts
 - SAE J2579 – Onboard Hydrogen Storage –
 - SAE J2578 – General Fuel Cell Vehicle Safety –NFPA 2 – Hydrogen Technologies Code – Working on 2010 release cycle
 - ISO TS14687-2 – Hydrogen Fuel Quality – coordinate North American team of experts
 - ISO 20100- Hydrogen fuelling stations-serve on technical committee
 - CSA Standards H4 series of standards
 - CSA America hydrogen standards for industrial trucks

Technical Accomplishment— NFPA 2 Hydrogen Technologies Codes

- NFPA 2 is a comprehensive hydrogen technologies code
- Chapters that cover the fundamental safety aspects of hydrogen applications followed by application specific chapters
- NREL and Sandia have supported the development of this code through
 - Analysis of data
 - Validation of CFD model for hydrogen releases
 - Incorporation of system leak data into new code requirements
 - Acting as principal committee members

Technical Accomplishment— Fuel Quality R&D and Testing

- Draft International standard (ISO 14687-2) 2010
 - Standard requires sufficient data and adequate level of confidence in data to set allowable limits for non-hydrogen constituents
 - Focus on “critical contaminants” that are technology and economic drivers
 - Include technical annex explaining rationale and data/modeling used to derive limits
 - SAE TIR J2719 being developed in coordination with ISO14687
- Coordinated testing and modeling wrapping up at national labs, universities in US, Asia, EC
 - North American team of experts represents U.S. and Canada at ISO
 - Similar team effort underway at SAE
 - ASTM standardized sampling and analytical methodologies under development by ASTM
 - Proposed methods are complete for all contaminants
 - Majority of methods have been successfully balloted
 - Inter-laboratory testing is being initiated to validate methods

Technical Accomplishment— SAE Standards Development

- NREL has supported the SAE work through:
 - Tank testing
 - Component testing
 - Direct participation on the Fuel Cell technical committee
- SAE Fuel Cell Technical Committee is responsible for the following documents:
 - J1766 Recommended Practice for Electric and Hybrid Electric Vehicle Battery Systems Crash Integrity Testing
 - J2572 Recommended Practice for Measuring Fuel Consumption and Range of Fuel Cell and Hybrid Fuel Cell Vehicles Fuelled by Compressed Gaseous Hydrogen
 - J2574 Information Report Fuel Cell Vehicle Technology
 - J2578 Recommended Practice for General Fuel Cell Vehicle Safety
 - J2579 Technical Information Report Fuel Cell Systems in Fuel Cell and other Hydrogen Technologies
 - J2594 Recommended Practice to Design for Recycling Proton Exchange Membrane (Pem) Fuel Cell Systems
 - J2600 Compressed Hydrogen Surface Vehicle Refueling Connection Devices
 - J2615 Testing Performance of Fuel Cell Systems for Automotive Applications
 - J2616 Testing Performance of the Fuel Processor Subsystem of an Automotive Fuel Cell System
 - J2719 Information Report on the Development of a Hydrogen Quality Guideline for Fuel Cell Vehicles J2760 Pressure Terminology Used in Fuel Cells and Other Hydrogen Vehicle00

Technical Accomplishment— CSA Component Standards

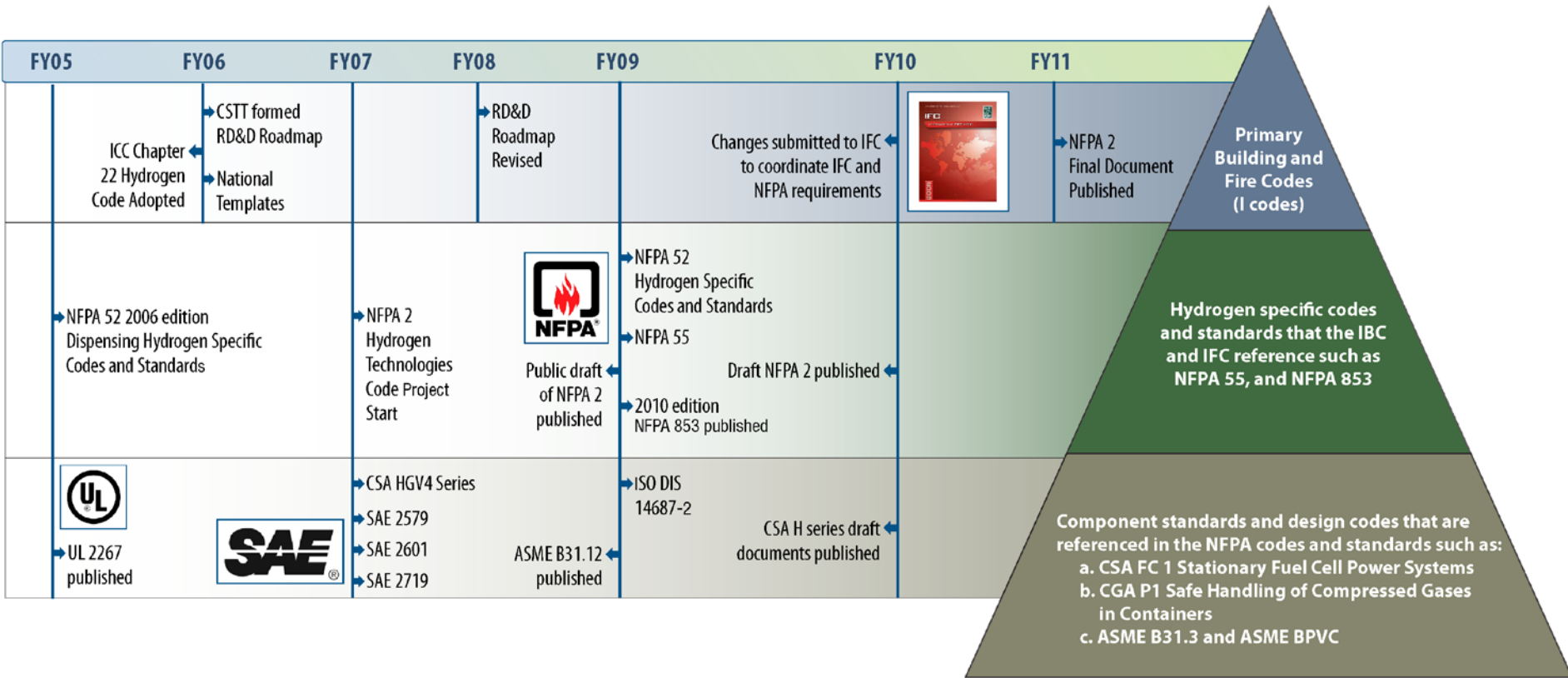
DOE/NREL has supported the development of the CSA standards shown below through:

- Administrative/technical support
- Providing data to validate standards
- Committee participation

CSA Component Standards cover the following topics:

- CSA America HGV 2 (draft) Fuel System Components for Hydrogen Gas Powered Vehicles
- CSA America HGV 3.1 (draft TIR) Hydrogen Gas Dispensing Systems
- CSA America HGV 4.1 (TIR) Hoses for Hydrogen Gas Vehicles and Dispensing Systems
- CSA America HGV 4.2 (TIR) Temperature Compensation Devices for Hydrogen Gas Dispensing Systems
- CSA America HGV 4.3 (draft TIR) Breakaway Devices for Hydrogen Gas Dispensing Hoses and Systems
- CSA America HGV 4.4 (TIR) Priority and Sequencing Equipment for Hydrogen Gas Dispensing Systems
- CSA America HGV 4.5 (TIR) Manually Operated Valves for Hydrogen Gas Dispensing Systems
- CSA America HGV 4.6 (TIR) Automatic Valves for Use in Hydrogen Gas Vehicle Fueling Stations
- CSA America HGV 4.7 (TIR) Hydrogen Gas Fueling Station Reciprocating Compressor Guidelines
- CSA America HGV 4.8 (draft TIR) Pressure Relief Devices for Hydrogen Gas Vehicle (HGV) Containers
- CSA America HPRD 1 (TIR)

Technical Accomplishments & Progress



Collaborations

The DOE Safety, Codes and Standards Subprogram

- DOE has helped develop a national template of SDOs and CDOs that perform hydrogen and fuel cell codes and standards development
- DOE through a Codes and Standards gap analyses, input from committee participation, coordinating groups, and codes and standards workshops identifies work areas
- DOE performs or directs research required to develop the codes and standards identified on the national template
- These codes and standards cover wide range of hydrogen and fuel cell applications
- There is variation among jurisdictions but these codes and standards are used fairly consistently across the US
- Coordinating the development of these codes and standards to ensure comprehensive coverage and timely development is critical function

Collaborations— DOE Support

By clicking on the SDO logo from the first slide, the user is guided to information on collaborative work within codes and standards, with online links.

Click on logos for more information

INTERNATIONAL ORGANIZATIONS

DOE/National Laboratory Representation in the Codes and Standards Development Process

Updated Nov 2010

SAE Society of Automotive Engineers

RESPONSIBILITY: Vehicle Standards

COMMITTEES:

- SAE Fuel Cell Technology Committee
 - SAE J1766
 - SAE J2572
 - SAE J2574
 - SAE J2578
 - SAE J2610
 - SAE J2615
 - SAE J2616
 - SAE J2617

SAE Society of Automotive Engineers: J2578

Document (s)	Technical Committee	Representative
SAE J2578	SAE J2578 Recommended Practice for General Fuel Cell Vehicle Safety	Robert Burgess, NREL Glenn Scheffler, Consultant to DOE Christine Sloane, Consultant to NREL

Hydrogen/Fuel Cell Codes & Standards Web links

- [SAE J2578](#)

Information from fuelcellstandards.com

DOE/National Laboratory Representation in the Codes and Standards Development Process

Updated Nov 2010

Milestones

- 7.1.1 Review national template status- complete, identified work area
- 7.1.2 Review of NREL coverage on codes and standards committees- will add additional coverage to CSA activities
- 7.1.3 Identify key projects requiring coordination- work on addressing indoor fueling requirements is an example of a key project
- 7.1.4 Coordination software functional- the graphic shown in the previous slide that allows access to current information on codes and standards development activities

Summary

- Research efforts to support implementation codes and standards development will be focused on component testing, hydrogen fuel quality testing, and hydrogen safety sensor testing
- Codes & standards development will continue through direct support of standards development organizations and participation on or operation of coordination committees
- These goals can only be accomplished through collaborations with key stakeholders at all levels
- NREL will continue to support technology readiness of hydrogen and fuel cell technologies through programs such as the workshops for permitting officials, safety reviews, and the web based information compendium