



2011 DOE Fuel Cell Technologies Program Codes and Standards Outreach for Emerging Fuel Cell Technologies



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May 11th, 2011

Project ID # SCS003

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Overview

T I M E L I N E

- **Start date: October 1, 2007**
- **End date: 10/2011***
- *Project continuation and direction determined annually by DOE

B A R R I E R S

- **Consensus** – Knowledge of codes and standards (*D,E*)
- **Technology Readiness** – Jurisdictional issues (*M*)

B U D G E T

- Funding received in FY10:
\$ 0.5M
- Funding for FY11:
\$ 0.25M

P A R T N E R S

- National Codes and Standards Coordinating Committee, CaFCP, CARB, various AHJs
- FreedomCAR and Fuel Partnership C&S Technical Team

Relevance/Objectives

- Advance hydrogen and fuel cell safety, codes and standards development, and market transformation by distribution of information
- Facilitate the safe deployment of renewable energy technologies
- Overcome barriers to hydrogen and fuel cell technologies, specifically fuel cell powered forklift vehicles and stationary fuel cells used for back up power
- Communicate directly with code user and enforcers
- Provide publicly accessible information on codes and standards

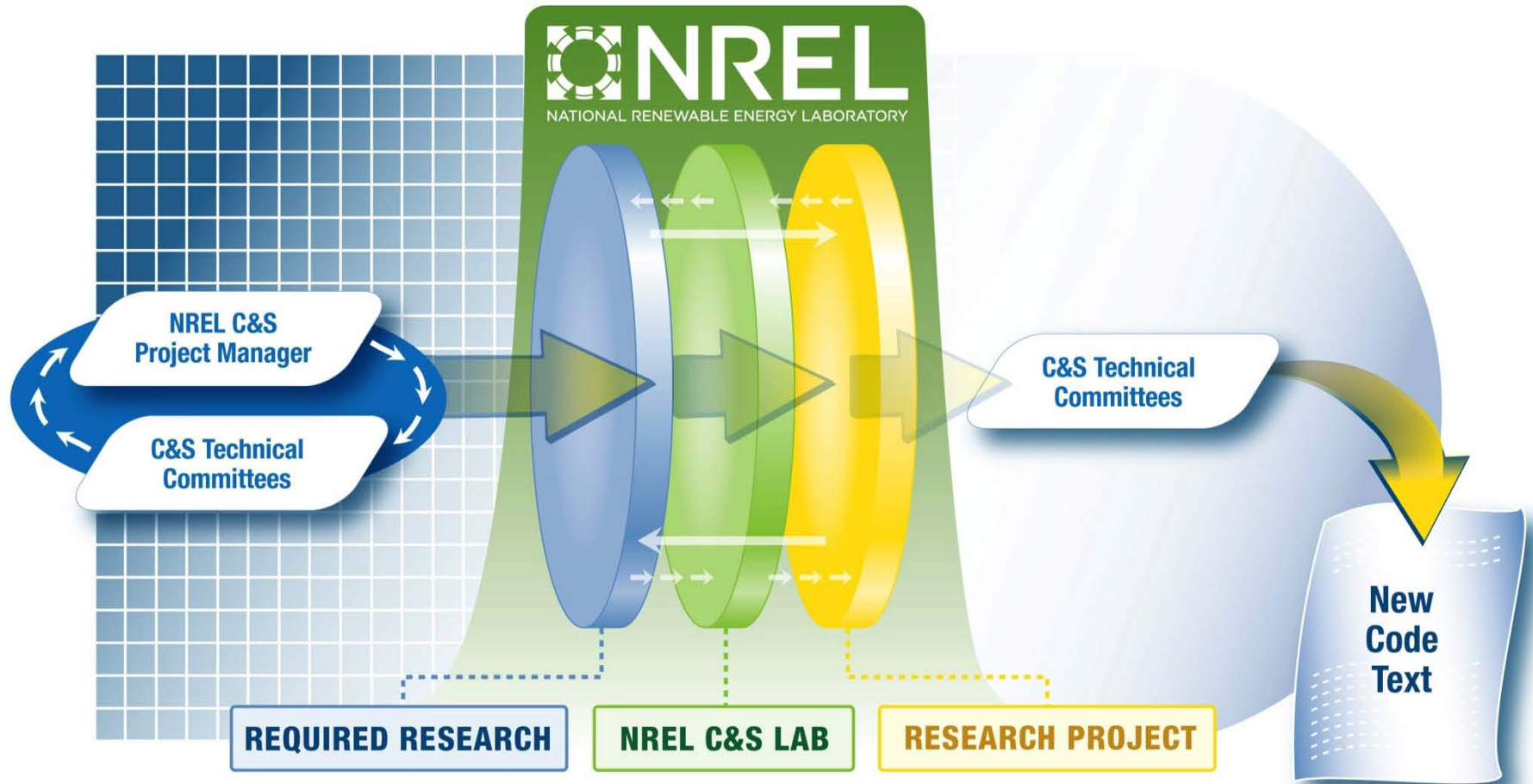
Approach

- Research and Development
 - Use workshops to help define research needs- for example evaluate the impacts of high pressure component failures
- Codes & Standards Coordination
 - Code and Standards workshops to help define codes and standards gaps
 - AHJs, FCHEA, CaFCP, CARB, SDO's, CDO's, Industry
- Support Technology Readiness/Market Transformation
 - Permitting workshops, web based information compendium, hydrogen fact sheets, third party safety reviews and site visits
 - NREL technical reports

Codes and Standards Project Approach

Fuel Cell Technologies *Codes and Standards Development Process*

Directed by NREL Codes and Standards Project Manager



Technical Accomplishments

- Conducted the following workshops in FY10:
 - May 25, 2010 San Francisco, CA in collaboration with the CAFCP
 - September 28, 2010 Los Angeles, CA in collaboration with the CAFCP and UCLA School of Engineering
- The following workshops are planned for remainder of FY11:
 - April 19, 2011 Los Angeles, CA in collaboration with the California Fuel Cell Partnership and Southern California Fire Protection Officers Association
 - June 8, 2011 Sensor Workshop Chicago, IL in collaboration with the multiple industry partners and national laboratories
 - July/August Lessons Learned Workshop in collaboration with multiple industry partners
 - September Codes and Standards Workshop East Coast location TBD
- Web based Information Compendium maintained and updated

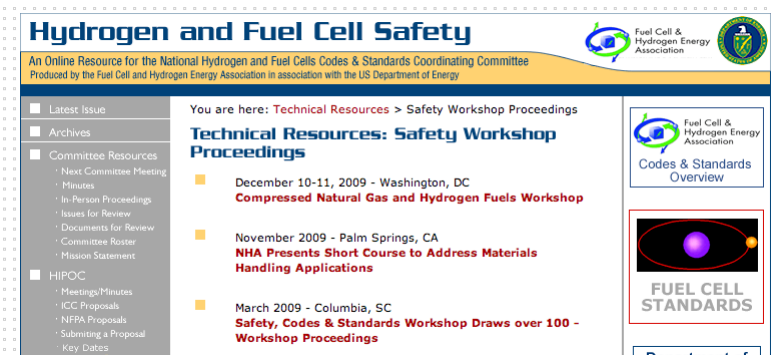
Technical Accomplishments

- Identified a key emerging fuel cell technology project for site visit including codes and standards evaluation:
 - Stationary fuel cell for back up power
 - Representative of widely used technology
 - Deployed in wide range of geographic locations
 - Codes and standards requirements relatively well defined
- Began work on a permitting template for hydrogen fueling stations:
 - will contain codes and standards citations for requirements used in many US jurisdictions
 - will contain a basic description and schematic of fueling station
 - will contain information on existing fueling stations

Technical Accomplishment— Codes and Standards Workshops

Workshops held in San Francisco, CA (May 10) & Los Angeles, CA (September 28)

- Held in key locations identified by Industry and Regional trade organizations with invited code officials and project developers
- Provide essential background on hydrogen and fuel cell technologies and electric vehicle deployment and applications
 - Hydrogen fueling stations
 - Hydrogen fuel cells in telecom applications
 - Electric vehicle safety and charging stations
- Provide workshop participants with with basic safety information and an overview of applicable codes and standards



The screenshot shows the 'Hydrogen and Fuel Cell Safety' website. The header includes the title and logos for the Fuel Cell & Hydrogen Energy Association and the Department of Energy. Below the header, there is a navigation menu on the left with categories like 'Latest Issue', 'Archives', 'Committee Resources', and 'HIPOC'. The main content area is titled 'Technical Resources: Safety Workshop Proceedings' and lists three workshops: 'Compressed Natural Gas and Hydrogen Fuels Workshop' (Dec 2009), 'NHA Presents Short Course to Address Materials Handling Applications' (Nov 2009), and 'Safety, Codes & Standards Workshop Draws over 100 - Workshop Proceedings' (March 2009). There are also sidebars with 'Codes & Standards Overview' and 'FUEL CELL STANDARDS'.

*Proceedings from selected workshops
on FCHEA website:*

[http://www.hydrogenandfuelcellsafety.info/
resources/workshops.asp](http://www.hydrogenandfuelcellsafety.info/resources/workshops.asp)

Technical Accomplishment— UCLA, Los Angeles Workshop

- Key workshop objective was providing information on codes and standards to code officials who will be directly involved in project review
- Attendees included key individuals such the
- Workshop conducted in partnership with the California Fuel Cell Partnership and the UCLA School Of Engineering

Technical Accomplishment— UCLA, Los Angeles Workshop Agenda

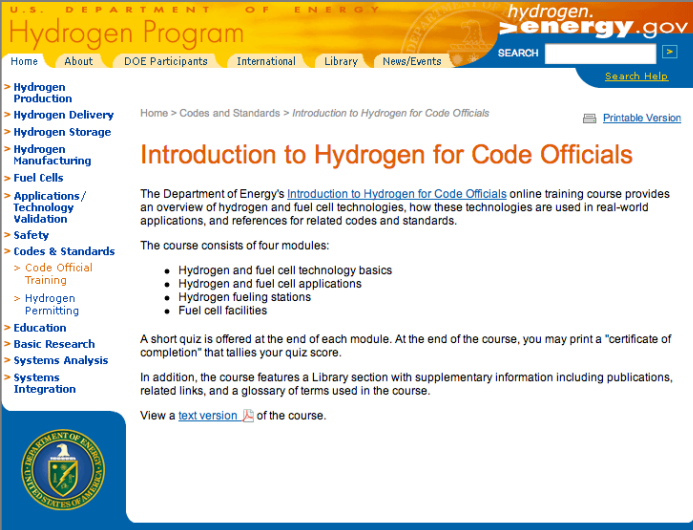
9:00 am – 9:30 am	Registration
9:30 am – 9:45 am	Welcome Remarks <i>Vasilios Manousiouthakis, Director of H.E.R.C.</i>
9:45 am – 10:00 am	Workshop Background and Objectives <i>Carl Rivkin, NREL</i>
10:00 am – 10:45 am	Overview of Renewable Energy Technologies and Alternative Energy Codes and Standards <i>Carl Rivkin, NREL</i>
10:45 am – 11:30 am	Emergency Response and Safety Systems <i>Jennifer Hamilton, California Fuel Cell Partnership</i>
11:30 am – 12:30 pm	Lunch
12:30 pm – 1:30 pm	Hydrogen Fueling Stations & Transportation <i>Todd Manner, Fielder Group</i>
1:30 pm – 2:00 pm	Permitting Website & Education Tools <i>Chad Blake, NREL</i>
2:00pm – 2:45 pm	Case Studies <i>Carl Rivkin, NREL</i>
2:45pm – 3:00 pm	Break
3:00 pm – 3:45 pm	Electric Vehicles <i>Chad Blake, NREL</i>
3:45 pm – 4:00 pm	Permitting Tool & Workshop Wrap-Up <i>Carl Rivkin, NREL</i>

Technical Accomplishment— UCLA, Los Angeles Workshop

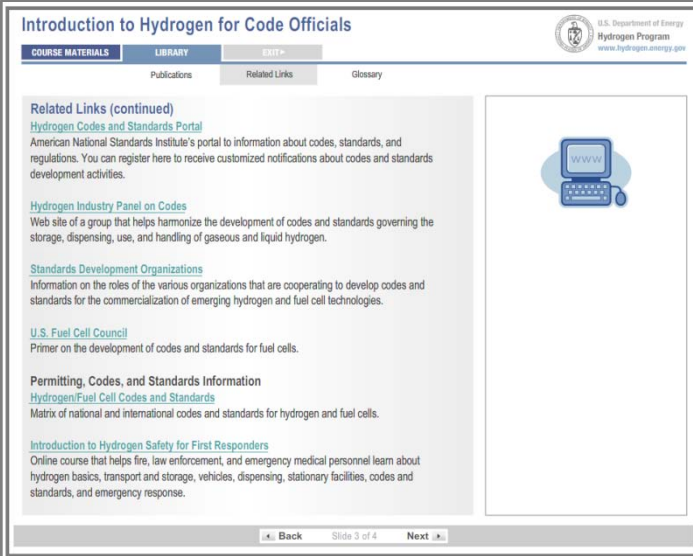
- Responses to the workshop.
- 93% of respondents felt workshop met expectations
- 93% respondents felt workshop increased their understanding of hydrogen basics
- 93% of respondents felt workshop provided useful information on safety issues
- 100% of respondents would recommend the workshop to their peers
- 93% of respondents felt workshop permitting tools were valuable

Technical Accomplishment— Code Officials Online Training Course

- Electric vehicle module added to web based Code Officials Training covers:
 - Types of electric vehicles
 - Battery technologies
 - Electric vehicle charging
- Additional deployments efforts will include:
 - Posting course links on key web sites
 - Presenting information on the course at codes and standards workshops
 - Large conferences and other key events
 - Certifying course for Continuing Education Units (CEUs)

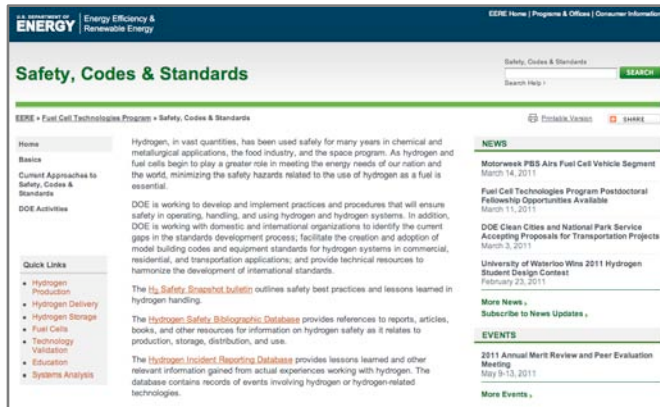


The screenshot shows the U.S. Department of Energy Hydrogen Program website. The page title is "Introduction to Hydrogen for Code Officials". The navigation menu includes Home, About, DOE Participants, International, Library, and News/Events. The main content area describes the course, which consists of four modules: Hydrogen and fuel cell technology basics, Hydrogen and fuel cell applications, Hydrogen fueling stations, and Fuel cell facilities. It also mentions a short quiz and a certificate of completion at the end of each module. A search bar and a "Printable Version" link are visible at the top right.



The screenshot shows the "Introduction to Hydrogen for Code Officials" course library page. The page is titled "Introduction to Hydrogen for Code Officials" and features a navigation bar with "COURSE MATERIALS", "LIBRARY", and "EXIT". The main content area is divided into sections: "Related Links (continued)", "Hydrogen Codes and Standards Portal", "Hydrogen Industry Panel on Codes", "Standards Development Organizations", "U.S. Fuel Cell Council", "Permitting, Codes, and Standards Information", and "Introduction to Hydrogen Safety for First Responders". Each section provides a brief description of the linked resource. A "www" icon is visible on the right side of the page. Navigation buttons for "Back" and "Next" are at the bottom.

Technical Accomplishment



- Information Compendium <http://www1.eere.energy.gov/hydrogenandfuelcells/codes/>
- The [Hydrogen Safety Bibliographic Database](#) provides references to reports, articles, books, and other resources for information on hydrogen safety as it relates to production, storage, distribution, and use.
- A [Permitting Hydrogen Facilities](#) Web site identifies model codes and standards to help local permitting officials deal with proposals for hydrogen fueling stations, fuel cell use for telecommunications facilities, and other hydrogen projects.
- The [Introduction to Hydrogen for Code Officials](#) Web-based course provides an overview of hydrogen and fuel cell technologies, how these technologies are used in real-world applications, and the codes and standards required for permitting them.

Technical Accomplishment— Codes and Standards Citations for Hydrogen Fueling Stations

http://www.hydrogen.energy.gov/permitting/search_stations.cfm

Search Results for Model Codes and Standards for Hydrogen Fueling Stations

Below are your search results.

ASME B31.3, Process Piping (American Society of Mechanical Engineers, 2006)

- F323.4(5) Specific Material Considerations-Metals
- IX K305 Pipe
- IX K306 Fittings, Bends, and Branch Connections
- IX K307 Valves and Specialty Components

ASME B31.8, Gas Transmission and Distribution Systems (American Society of Mechanical Engineers, 2003)

CGA G-5.4, Standard for Hydrogen Piping Systems at Consumer Locations (Compressed Gas Association, 2005)

- 3.0 Piping System Criteria
- 3.1 General
- 3.2 Piping Materials
- 3.3.2 Isolation Valves
- 3.3.3 Emergency Isolation Valves
- 3.3.4 Excess Flow Valves
- 3.3.5 Check Valves
- 3.3.7 Gasket and Sealing Materials
- 3.3.8 Additional Requirements
- 5.0 Installation
- 5.1 Piping Installation General
- 5.1 Installation General
- 5.2 Piping Installation Above Ground Installation
- 5.3 Piping Installation Underground Installation
- 7.0 Maintenance and Repair

CGA G-5.5, Hydrogen Vent Systems (Compressed Gas Association, 2004)

- 6.0 Vent System
- 6.2 Sizing
- 6.3 Design
- 6.4 Materials
- 6.5 Components
- 7 Installation
- 9 Maintenance

The screenshot shows the 'Permitting Hydrogen Facilities' page on the hydrogen.energy.gov website. The page is divided into two main sections: 'Hydrogen Fueling Stations' and 'Telecommunication Fuel Cell Use'. Each section has a 'Model Codes Search' button. A red box highlights the 'Model Codes Search' button under 'Hydrogen Fueling Stations', and a red arrow points from this box to the search results page shown below. The search results page lists various topics for model codes and standards, including 'Annual Inspections', 'Balance of Plant', 'Piping and Tubing', 'Pressure Relief', 'Valving and Fittings', 'Venting and Other Equipment', 'Canopy Tops', 'Compressed Hydrogen Gas Storage', 'Equipment Location', 'General Safety Requirements', 'Storage Containers', 'Compression Systems and Equipment', 'Design', 'Barrier Walls', 'Equipment', 'Fuel Stations', 'Weather Protection', 'Dispensing', 'Electrical Equipment', 'Fuel Lines', 'Gaseous Dispensers', 'Hoses and Connectors', 'Liquid Dispensers', 'Vehicle Connectors', 'Dispensing, Operations, and Maintenance Safety', 'Gaseous Hydrogen', 'Liquid Hydrogen', 'Fire Safety', 'Construction', 'Equipment', 'Liquids Hydrogen Storage', 'Equipment Location', 'General Safety Requirements', 'Storage Containers', 'On-Site Hydrogen Production', 'Operation Approvals', 'Dispensing', 'Fire and Emergency Planning', 'Fuel Delivery', 'Ignition Control', 'Personnel Issues and Training', 'Vehicle Access', 'Setbacks and Footprints', 'Liquid Systems', 'Outdoor Gaseous Systems', 'Transportation', 'Compressed Hydrogen Gas', 'Signage', 'Liquid Hydrogen', 'Natural Gas', and 'Vaporizers'. A 'Search Topics' button and a 'Reset' button are also visible at the bottom of the search results page.

Technical Accomplishment— Codes and Standards Citations for Stationary Fuel Cells

http://www.hydrogen.energy.gov/permitting/search_stations.cfm

Search Results for Model Codes and Standards for Telecommunications Fuel Cell Use

Below are your search results.

ANSI/CSA America FC 1-2004, Stationary Fuel Cell Power Systems (American National Standards Institute and Canadian Standards Association, 2004)

- 1.2 Power Systems Design
- 1.2 Power Systems Design
- 1.3 General Design Requirements
- 1.3 General Design Requirements
- 1.3.2 Protection from Environmental Conditions
- 1.3.3 Electrical Safety
- 1.3.5 Steam Backflow
- 1.3.6 FC System Purging
- 1.3.7 Safe Handling During Moving
- 1.3.8 Shock and Vibration Protection
- 1.3.9 Requirements for Not-Listed Equipment
- 1.3.11 Temperature Limits
- 1.4 Materials
- 1.4 Materials
- 1.5 General Construction and Assembly
- 1.6 Enclosures and Associated Construction
- 1.6 Enclosures and Associated Construction
- 1.8.1 Metallic Piping
- 1.8.1 Metallic Piping
- 1.9 Drain, Venting and Ventilation Exhaust Systems
- 1.12.1 Manual Valves
- 1.12.2 Automatic Valves
- 1.12.3 Pressure Regulators
- 1.15 Electrical Equipment and Wiring
- 1.18.2 Maintenance Manual
- 1.19.1 Materials for Markings
- 1.19.1 Materials for Markings
- 1.19.2 FC Labeling Requirements
- 1.19.2 FC Labeling Requirements
- 1.19.4 - 1.19.7 Electrical Diagrams
- 1.19.4 - 1.19.7 Electrical Diagrams

CGA P-1, Safe Handling of Compressed Gases in Containers (Compressed Gas Association, 2006)

- 4.1 Transportation Regulating Authorities
- 4.2 Container Regulations
- 4.3 Container Filling Regulations
- 4.4 Regulating Authorities of Employee Safety and Health
- 6.2 Flammable Gases

The screenshot shows the 'Hydrogen Program' website with a search bar and a list of search results. The search results include 'ANSI/CSA America FC 1-2004, Stationary Fuel Cell Power Systems' and 'CGA P-1, Safe Handling of Compressed Gases in Containers'. The website also features a navigation menu with options like 'Permitting Process', 'Codes & Standards Search', and 'Hydrogen Fueling Stations'. There are also images of a hydrogen fueling station and a telecommunications tower.

Technical Accomplishment— Report on Stationary Fuel Cell Installation

The technical report will include the following elements:

- Project description and background including project funding information if available
- Comprehensive codes and standards evaluation including any issues that might help with compliance at other sites
- Recommendations on any compliance issues
- Recommendations on how the findings could be applied to other projects
- Photographs of the site and equipment (if allowed)

Collaborations



CAFCP



AHJs such as the Southern California Fire Protections Officers

Industry

Milestones

- 7.3.1 Codes and Standards workshop plan defined
 - 4 workshops
 - 2 codes and standards workshops, 1 sensor workshop, and 1 lessons learned workshop
- 7.3.2 Identify site for third party safety analysis- stationary fuel cell for backup power
- 7.3.3 identification of permitting template components
 - Publication of NFPA 2 will help organize components
 - Fire code and component standards will be key pieces of the template

Proposed Future Work

- Continue outreach activities such as workshops and safety reviews and site visits
- Workshops will be planned and delivered in close collaboration with local and regional organizations for codes and standards workshops
- Topical workshops, such a sensor workshop, will be held to maximize participation of interested parties
- Continue to extend web based compendium to include information on newly issued codes and standards and new hydrogen and fuel cell applications
- Issue case studies on emerging fuel cell technology projects as NREL technical reports and add links to these reports to the web compendium

Summary

- NREL will continue to support technology readiness of renewable energy technologies through programs such as the workshops for code officials, project developers and other interested parties safety reviews, and the web based information compendium that includes on line training
- Workshops will be focused on geographic areas where there is project activity and desired attendees are code officials, project developers, and other interested parties who will be directly involved in project work
- Look to workshops to help define potential codes and standards issues as well as research and development efforts
- Technical reports documenting site visits will assist code official and project developers