



Fuel Cell &  
Hydrogen Energy  
Association

# Fuel Cell & Hydrogen Energy Association Codes and Standards Support

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Fuel Cell and Hydrogen Energy  
Association (FCHEA)

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Project ID #  
SCS022

# Overview

## Timeline

- Project start date: 11/2011
- Project end date: 11/2015\*

\* Project continuation determined annually by DOE

## Budget

- FY14 DOE Funding:  
\$274,868
- Planned FY15 DOE Funding:  
\$200,000
- Total DOE Project Value:  
\$844,868\*

\* Previous subcontract thru NREL

## Barriers

- F. Enabling National and International Markets Requires Consistent RCS
- H. Insufficient Synchronization of National Codes and Standards
- J. Limited Participation of Business in the Code Development Process

## Partners

- Interactions/ collaborations: FCHEA Members; CDOs & SDOs through NHFCCSCC and direct participation
- Project Lead -ORNL- Prime Contract

# Relevance

- FCHEA project contributes directly to achievement of four of the seven objectives outlined in the Fuel Cell Technologies Office Multi-Year Research, Development and Demonstration Plan, Chapter 3.7, Hydrogen Safety, Codes, and Standards:
  - Support and facilitate development and promulgation of essential codes and standards by 2015 to enable widespread deployment and market entry of hydrogen and fuel cell technologies and completion of all essential domestic and international RCS by 2020.
  - Ensure that best safety practices underlie research, technology development, and market deployment activities supported through DOE-funded projects.
  - Conduct R&D to provide critical data and information needed to define requirements in developing codes and standards.
  - Develop and enable widespread sharing of safety-related information resources and lessons learned with first responders, authorities having jurisdiction (AHJs), and other key stakeholders.

# Relevance - Objectives

- Support and facilitate development and promulgation of essential codes and standards by 2015 to enable widespread deployment and market entry of hydrogen and fuel cell technologies and completion of all essential domestic and international RCS by 2020.
  - FCHEA participates directly in key domestic and international RCS technical committees; and encourages members to participate directly in appropriate technical committees, working groups or discussions. Member companies can therefore participate directly or indirectly as appropriate.
    - ISO/TC 197 – many new work groups to support gaseous hydrogen refueling; as well as revisions to published standards
    - IEC/TC 105 – fuel cell requirements with efforts to harmonize with national standards and international regulations
    - CSA Fuel Cell Standards Committee
    - NFPA 2: Hydrogen Technologies
    - ICT Fuel Cell Guidance for the Telecommunications Industry Association
    - Others as needs arise

# Relevance to DOE Objectives

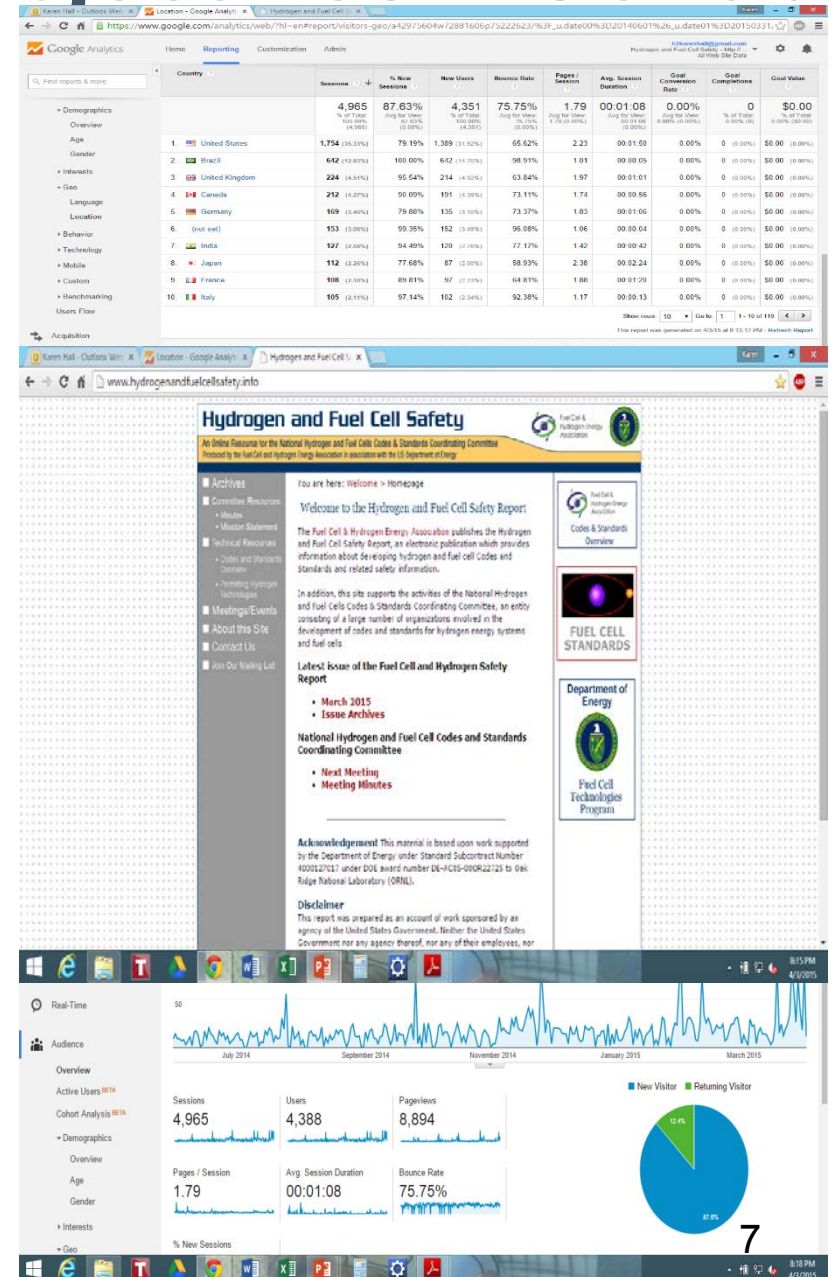
- Ensure that best safety practices underlie research, technology development, and market deployment activities supported through DOE-funded projects.
  - FCHEA supports information-sharing of pre-competitive safety information
    - Open discussions during FCHEA Working Group and Task Force meetings between codes and standards development organizations, researchers, government and industry. Aids harmonization of requirements and enhances collaboration.
    - Identify and schedule Topical Discussions during monthly meetings of the National Hydrogen and Fuel Cell Codes & Standards Coordinating Committee (NHFCCSCC) which FCHEA administers. Enables industry priorities to be discussed and synergistic activities to be coordinated.
    - Posting and/or linking data, workshop proceedings, and other informational resources online at [www.hydrogenandfuelcellsafety.info](http://www.hydrogenandfuelcellsafety.info)

# Relevance to DOE Objectives – Cont'd

- Conduct R&D to provide critical data and information needed to define requirements in developing codes and standards.
  - FCHEA conducts forums to identify R&D needs, and engages in dialog with DOE; providing a mechanism for input and feedback into DOE R&D plans and activities.
    - FCHEA Working Groups set industry priorities and engage in related activities with outside organizations. (Examples: TIA, component manufacturers)
    - Direct participation in National CDO/SDO Technical Committees
      - Examples include SAE, CSA standards development, model code development, engagement with hydrogen component manufacturers
    - Direct participation in US TAG for ISO/TC 197 and IEC/TC 105
    - Facilitations and documentation of monthly NHFCCSCC meetings
    - Monthly summary reports
    - Strategic meetings of FCHEA Board of Directors and Executive Committee
      - DOE is invited to engage with industry in discussions of accomplishments and challenges.

# Relevance to DOE Objectives – Cont'd

- Develop and enable widespread sharing of safety-related information resources and lessons learned with first responders, authorities having jurisdiction (AHJs), and other key stakeholders.
- *The Hydrogen and Fuel Cell Safety Report* is read by thousands of interested parties all over the world. 2,200 people, including AHJs and first responders, have signed up to receive E-mail notification when new issues are posted. Many others find it through Internet searches and bookmarks.



# Relevance - Impact

- Enabling National and International Markets Requires Consistent RCS
  - Lack of consistency limits international trade and markets.
    - This is a key issue identified by industry, and is the reason that we work to ensure developing standards are technically consistent with published standards.
- Insufficient Synchronization of National Codes and Standards
  - The codes and standards development and revision cycles established by SDOs vary and are difficult to coordinate or synchronize even under a consensus national agenda.
    - FCHEA maintains a matrix to provide a single resource for stakeholders to see which activities are active, what the status and next steps are, and when documents are published or opened for revision.
    - FCHEA facilitates the monthly meetings of the NHFCCSCC, where CDOs/SDOs can share information about timing and issues; and where industry and researchers can engage in the discussion and provide essential linkages.
    - FCHEA staff participates directly in the key national and international codes and standards technical committees to provide consistency.
- Limited Participation of Industry in the Code Development Process
  - Businesses, particularly small businesses, do not have the resources to participate in the codes and standards development process.
    - Participation in FCHEA RCS Working Groups allows these businesses opportunities to be briefed on the RCS efforts of interest; to weigh in on issues that arise; and to review documents in order to develop a FCHEA comment or position.
    - The Hydrogen and Fuel Cell Safety Report and the FCHEA Regulatory Matrix provide quick overview information



# Sample Page from Matrix

FCHEA Regulatory Matrix markup March 31\_2015.pdf - Adobe Reader

File Edit View Window Help

Open [Icons] 1 / 12 75% [Icons] Tools Fill & Sign Comment

Significance to Commercialization  
 ↩ More Critical  
 Highest Effort

← Significance

A. Essential To or Enables Commercialization	B. Important to Commercialization	C. Supports Commercialization
<p>US DOT Harmonization NPRM – HM215L: Proposed rule on Hazardous Materials: Harmonization with International Standards – FCHEA submitted comments supporting harmonization and reiterating comments on HM215K. Both HM215L and the response to the final rule and the appeal on HM215K were published in January 2013. Harmonization with IEC 62282-6-100 for both carry on and checked baggage; however DOT continues to not be harmonized with inclusion of division 2.1 and 4.3 fuel cartridges for checked baggage. (micro fuel cell applications)</p> <p><i>Recent Court of Appeals decision is expected to yield additional required activity (with DOT) publication of DOT rationale 49 CFR Part 175 [Docket No. PHMSA-2009-0126, Notice No. 15-3]</i></p> <p><u><a href="#">Hazardous Materials: Spare Fuel Cell Cartridges Containing Flammable Gas Transported by Aircraft in Passenger and Crew Member Checked Baggage available at <a href="http://www.gpo.gov/fdsys/pkg/FR-2015-03-30/pdf/2015-07109.pdf">http://www.gpo.gov/fdsys/pkg/FR-2015-03-30/pdf/2015-07109.pdf</a></a></u></p> <p><i>Now Proposed Rule: HM215M: comments on NPRM were due Oct 24th. Don't appear to be substantive changes relating to portable fuel cells, however there are new restrictions pertaining to lithium-ion batteries. Manufacturers of hybrid systems should take a look.</i></p>	<p>ICAO <i>Technical Instructions for the Safe Transport of Dangerous Goods by Air</i>: published every two years. <i>2013 edition includes references to IEC 62282 – 6 – 100 for both carry on and checked baggage, October 2012, inclusion of A1 approved for inclusion by addendum. Publication of addendum 3 occurred June 10, 2013. (micro fuel cell applications)</i></p> <p>Work commencing to clarify restrictions on charging of batteries by fuel cell devices. Future work anticipated as edition 2 of IEC 62282-6-101 nears completion to more explicitly include new technologies in the regulations.</p> <p><i>Next ICAO technical instructions <u>took</u> effect January, 2015.</i></p> <p>Cargo Shipping regulations of Fuel Cells, Fuel Cell Cartridges, Fuel Cell Engines and Fuel Cell Vehicles: in force now, revised periodically. Ongoing discussions related to definitions of "articles" as well as classification test methods for Div 4.3 water-reactive substances and treatment of engine-containing fuel are ongoing.</p> <p>UN Sub-Committee of Experts (cargo shipping)</p>	<p>CARGO</p> <div style="position: relative; height: 150px;"> <div style="position: absolute; top: 0; right: 0; font-size: 2em;">↑</div> <div style="position: absolute; top: 50%; left: 50%; transform: translate(-50%, -50%); transform-origin: center;"> <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Level of Effort</p> </div> </div>
<p>IEC 62282-4-102: Fuel cell systems for forklift applications – Performance requirements and test procedures: <u>Approved for 2nd Committee Draft</u> <u>All 7 USTAG comments to the 1st Committee Draft were accepted</u> <u>Approved for a 2<sup>nd</sup> CD.</u></p>		<p>VEHICLES</p>

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# Approach: FCHEA WGs

## **FCHEA Working Groups provide regular opportunities to engage industry in developing RCS:**

### **Transportation WG**

- Transportation Infrastructure standards, R&D, deployment.
- Hydrogen Codes Task Force
  - Produced public code change proposals for NFPA 2
- Special Task Force for strategic planning
  - New activity to begin to plan ahead for future roll-out of infrastructure and identify necessary revisions in model codes

### **Stationary Power WG**

- Supports the Telecommunications Industry Association's (TIA) focus group on fuel cells and tracks RCS relating to Stationary Power.
  - Recent topics include the TIA focus group, a call for participation in CSA Standards Development, Grid Interconnect Standards; and Greenhouse Gas Emission regulations.

### **Portable Power WG**

- Complete regulatory framework to ship and to allow consumer transport of FCs and FC cartridges to be regulated in parity with similar technologies.
- RCS from UL, CSA, DOT, the UN, ICAO, IEC and others.
  - Encourage international harmonization of requirements; adoption of international standards into regulations, and equal opportunity for all micro fuel cell technologies.

# Approach: Coordination and Outreach

## NHFCCSCC (monthly)

- Forum for effective communication and collaboration
- Facilitates the development of the consensus-based C&S
- Identifies critical gaps and makes recommendations to address them.

## Safety Report (bi-monthly)

- Central source of information on RCS activities and issues
- Improves coordination of RCS activities and information transfer
- Meetings of the NHFCCSCC
- Summarizes key domestic and international RCS issues
- List key upcoming events and issues



The screenshot shows the website for Hydrogen and Fuel Cell Safety. The header includes the title "Hydrogen and Fuel Cell Safety" and logos for the National Hydrogen and Fuel Cells Codes & Standards Coordinating Committee and the Fuel Cell and Hydrogen Energy Association. The main content area is titled "March 2015" and lists several news items, each with a yellow square icon and the author's name, Karen Hall, FCHEA. The items include:

- FCHEA Workshop to Engage Hydrogen Station Component Manufacturers
- FCHEA to host International Working Groups
- Importance of Micro Fuel Cell Expert Participation in Developing Standards
- Interview with ISO/TC 197 Chairman
- International Documents on Gaseous Hydrogen Dispensers and Valves Circulated
- Metal Hydride Standard to be Revised
- Hydrogen Reformer Standard up for Systematic Review
- Liquid Hydrogen Fuel Tank Standard up for Systematic Review
- National Hydrogen and Fuel Cells Codes & Standards Coordinating Committee Teleconference - January, 2015 Minutes (PDF)
- National Hydrogen and Fuel Cells Codes & Standards Coordinating Committee Teleconference - February, 2015 Minutes (PDF)

On the right side of the page, there are three additional logos: the Fuel Cell and Hydrogen Energy Association Codes & Standards Overview logo, the FUEL CELL STANDARDS logo, and the Department of Energy Fuel Cell Technologies Program logo.

# Approach to Resolve Technical Challenges

- Challenge: Development and Harmonization of Regulations, Codes and Standards
  - Facilitate the development of clear and comprehensive codes and standards to ensure consistency and facilitate deployment of hydrogen and fuel cell technologies
  - Reduce competition between individual SDOs and to minimize duplication in domestic codes and standards development. Coordinated development of international standards is also a key challenge.

**APPROACH:** Technology and application-specific forums to identify issues and discuss progress and needs in developing RCS; open dialog between CDOs/SDOs, government and research organizations, industry and users; Direct Participation in RCS-development activities; and information dissemination and outreach to develop consensus requirements to ensure consistency.
- Challenge: Dissemination of Data, Safety Knowledge, and Information
  - General lack of understanding of hydrogen and fuel cell safety needs among local government officials, fire marshals, and the public. Failure to comprehensively consider the properties and behavior of hydrogen may lead to overly restrictive policies that preclude or delay deployment of hydrogen and fuel cell technologies.

**APPROACH:** FCHEA publishes, maintains, and disseminates key safety information through the *Hydrogen and Fuel Cell Safety Report* website at [www.hydrogenandfuelcellsafety.info](http://www.hydrogenandfuelcellsafety.info); and works with stakeholders to disseminate FCV and infrastructure-deployment activities, internally as well as externally. Recent activity – direct engagement with component manufacturers to contribute to harmonized requirements and identify concerns and challenges.
- Milestones: Monthly summaries, bi-monthly Safety Report
  - Aligned with the Go/No-Go Decisions in DOE's current plans. Provides regular mechanism to identify and address industry priorities.

# Accomplishments and Progress: Portable Power

- Standards and Regulations for micro fuel cells
  - Working to ensure International Standards are inclusive of all fuel types. IEC 62282-6-101 Edition 2, and associated “fuel specific” Part 2 documents. Held open meeting to reach out to manufacturers.
  - Ensuring that appropriate international standards for shipping of fuel cells and fuel cell cartridges are included in the ICAO Technical for the Safe Transport of Dangerous Goods by Air.
  - Provided comment on NPRM – HM215L: Proposed rule on Hazardous Materials: Harmonization with International Standards, to ensure harmonization with international standards for fuel cells as carry on and checked baggage.
- **Significance:** Supports Objective from MYPP - Enabling National and International Markets Requires Consistent RCS by ensuring national and international standards for micro fuel cell applications are harmonized, then adopted by International Regulations.
- **Take Home Message:** Regular dialog in FCHEA WGs and consistent messaging and participation in relevant RCS forums can result in consistent RCS.

# Accomplishments and Progress: Transportation and Stationary

- **TWG:** Infrastructure RCS review. Administers Hydrogen Codes Task Force to review and develop public input for NFPA 2. Initiated new Special Task Force for Strategic Planning to begin to develop comments for next round of model codes.
  - Task Group provided and tracked public inputs through the latest NFPA 2 development cycle. The public inputs all address harmonizing requirements with other industry-accepted standards and codes.
  - **Significance:** Supports Objective from MYPP – Provides consistent RCS and synchronization of national codes and standards.
  - **Take Home Message:** FCHEA WGs and TFs work collaboratively with others to effectively make changes to developing RCS
- **SPWG:** Forum for engaging in the development of RCS for stationary applications. FY 13 a fuel cell focus group was created by the Telecommunications Industry Association (TIA). FCHEA's SPWG provides support and fuel cell experts, and assisted in populating a new draft guideline with relevant information from existing codes, standards, and guides. WG also reviewed and is developing input on issues relating to GHG emissions accounting.
  - **Significance:** Supports Objective from MYPP – Develop and enable widespread sharing of safety-related information resources and lessons learned with first responders, authorities having jurisdiction (AHJs), and other key stakeholders. Provides consistency in requirements and reduces duplication of effort.
  - **Take Home Message:** FCHEA works with other stakeholders, even where FCHEA is not leading the activity, to ensure valuable resources are shared.

# Accomplishments and Progress

- **Coordination**

- **NHFCCSCC** – Monthly facilitated discussion of new key topics of broad interest, such as “Facilitating Deployment”. Progress in the development of RCS is reported and captured for the FCHEA Regulatory Matrix, providing an up-to-date overview of current industry priorities and recent progress in RCS.
- **Hydrogen & Fuel Cell Safety Report** – Published every two months, keeping readers informed of the progress and issues encountered in the development of RCS. Has introduced industry to the many new WGs in ISO/TC 197 and the call for participation in US standards committees. Calendar of events aids in scheduling meetings.
- **Significance:** Contributes to DOE goal to develop and enable widespread sharing of safety-related information resources and lessons learned with first responders, authorities having jurisdiction (AHJs), and other key stakeholders. Increases participation of stakeholders in development of harmonized RCS.
- **Take-Home Message:** FCHEA is building relationships and working directly with stakeholders to identify and address issues in order to ensure consistency in RCS and facilitate deployment of hydrogen and fuel cell technologies.

# Responses to Previous Year Reviewers' Comments

- The project has made accomplishments in communicating and coordinating information regarding various hydrogen codes and standards. The specific contributions of the project should be highlighted in future reviews. It is unclear whether the project is simply monitoring or actually involved in accelerating the standards.
  - Specific examples of how FCHEA members contribute to the development of codes and standards are given throughout this year's presentation. (See matrix slide)
- The project should become more engaged with the activities of all the SDOs and leverage the membership to generate high-quality, timely product standards.
  - Members engage directly with the SDOs, or prepare positions for a designated representative (often staff) to provide input into the product standards. SDOs participate in FCHEA working group meetings . Monthly NHFCCSCC coordination meetings - Regular reports are provided by SAE, ISO/TC 197, IEC/TC 105, ICC, NFPA, CSA, and NIST (legal metrology standards). Periodic reports from ASTM, UL, ASME, and California Weights and Measures.
- A more visible presence with the SDOs and the assisting of the SDOs in getting experienced personnel active in the generation of the product safety standards would accelerate the process and improve the quality of these standards, which are the supporting documents to the building and fire codes.
  - In 2015 FCHEA has targeted hydrogen fueling station component manufacturers based on expressed needs and priorities in developing harmonized national and international requirements for deployment of hydrogen fueling infrastructure. Direct benefit to CSA and ISO standards development.
  - In 2015 FCHEA staff was directly engaged with SAE, participating in meetings by webinar as well as a key quarterly meeting in person in March. This meeting included a workshop to address international round robin testing for hydrogen materials compatibility. The June in-person SAE meeting is taking place the same week as the AMR. FCHEA staff plan to attend the next in-person meeting in September.



# Collaborations

- FCHEA performs this work with ORNL.
- FCHEA members represent the full global supply chain, including universities, government laboratories and agencies, trade associations, fuel cell materials, components and systems manufacturers, hydrogen producers and fuel distributors, utilities and other end users. Members direct our activities, provide input to RCS through FCHEA involvement; review and prioritize our efforts.
- CDOs/SDOs through direct participation on RCS activities, participation in the NHFCCSCC, and participation in appropriate FCHEA WGs. This facilitates information-sharing and synchronization.
- FCHEA works with the full range of stakeholders, including industry, state and local officials, and others to address RCS and outreach needs and facilitate deployment.
- FCHEA works closely with DOE to facilitate productive dialog on industry priorities, R&D needs, and deployment barriers; as well as to promulgate R&D results and information and data resources available through DOE-funded projects.

# Remaining Challenges and Barriers

- The four objectives supported by this project are ongoing. Objectives are structured to be reached by 2015 to 2020.
- Further advances on US Model Codes. This includes reference to available harmonized standards. Updated Permitting Guidance is needed to aid the AHJs. Emergency Responders guidance for regions outside California.
- US harmonization with IEC 62282-6-100 for inclusion of division 2.1 and 4.3 fuel cartridges for checked baggage.
- The ICT Fuel Cell Guideline is in development. User feedback on the draft will be available later this year.
- International standards need to develop in a coordinated fashion to ensure they reflect the needs of industry and consistency with accepted practices.
  - Significant progress: ISO/TC 197 WGs on hydrogen fueling stations and components.
    - International Standards on hydrogen fueling stations, dispensers, compressors, fittings, valves, hoses all being coordinated internationally and nationally.
  - Progress: Published standards being updated to reflect advances and learnings.
    - Residential and industrial Electrolysers documents, hydrogen stored in metal hydrides, gaseous hydrogen vehicle tanks.
  - Significant work remaining: Component standards – significant effort launched this year to engage more component manufacturers in development of requirements, and to understand their concerns and issues. US experts beginning to map out the similarities and differences between US best practice and developing international requirements.

# Proposed Future Work

- **PPWG:** To ensure harmonization with international standards for fuel cells as carry on and checked baggage. DOT continues to not be harmonized with inclusion of division 2.1 and 4.3 fuel cartridges for checked baggage (micro fuel cell applications). FCHEA is pursuing inquiry within the US DOT PHMSA to determine options to have these regulations harmonized.
- **TWG:** Special Task Force for Strategic Planning – In advance of the next round of code revisions, predict potential needs (ex. Low grade storage at a station). A small task force who can think outside of the box for future needs, as well as come up with proposals for the existing code language and see what other changes / improvements need to be made. Continue dialog with component manufacturers to resolve issues in advance of infrastructure roll-out.
- **SPWG:** Work with TIA to complete the guideline for fuel cells in the telecommunications industry. Continue to review international standards and US as well as state regulations to ensure consistency with accepted US requirements and best practices.
- **Coordination:**
  - **NHFCCSCC** – continue to administer, identify key issues, and document discussions and outcomes. Provide industry feedback and other input to the Department of Energy (DOE) Safety and Codes and Standards Subprogram on RCS development needs and priorities; outreach needs and priorities; R&D needs and priorities to support RSC development activities.
  - **Safety Report** – continue to report on the developing RCS to improve coordination of activities and improve information transfer.
- **Technology Transfer Activities:** We develop consensus and information rather than technologies. These are shared openly at [www.hydrogenandfuelcellsafety.info](http://www.hydrogenandfuelcellsafety.info). We also hold regular working group meetings, monthly coordination webinars, and web-based workshops/webinars to reach beyond our membership.

# Project Summary

- **Relevance:** FCHEA project contributes directly to achievement of four of the seven objectives outlined in the Fuel Cell Technologies Office Multi-Year Research, Development and Demonstration Plan. Project facilitates industry participation in essential codes and standards to meet DOE goals.
- **Approach:** Multi-tiered approach: forums to identify issues and discuss progress and needs in developing RCS; facilitating open dialog; participating directly in national and international RCS-development activities; information dissemination & outreach tools.
- **Technical Accomplishments:** Significant progress in harmonizing national and international requirements for transportation of portable fuel cells in passenger aircraft; proposals to improve harmonization in domestic RCS; maintained central point of information for RCS activities; identified and communicated needs in RCS, R&D, and outreach.
- **Proposed Future Work:** Continued focus on harmonization of requirements to facilitate deployment; ensure international standards are consistent with US practices; continue building relationships with key stakeholders, including outside associations such as TIA – complete ICT fuel cell guideline; follow up on component manufacturer workshop held in April to facilitate deployment of hydrogen infrastructure; strategic planning for next code revision cycle.

# Backup Slides

# FCHEA Members

FCHEA represents members throughout the global supply chain of the fuel cell and hydrogen energy industry, including fuel cell manufacturers and component suppliers, industrial gas suppliers, automakers, energy companies, non-profits, national laboratories, associations, and others. Our members as of 4/9/15 are:

- 3M
- Air Liquide
- Air Products and Chemicals
- American Honda Motor Company
- ARC: Hydrogen
- AREVA
- Ballard Power Systems
- Bloom Energy
- BMW of North America, Inc.
- California Air Resources Board
- California Fuel Cell Partnership
- Connecticut Hydrogen-Fuel Cell Coalition
- CSA Group
- Daimler
- Doosan Fuel Cell America
- Fuel Cell Seminar & Energy Exposition
- FuelCell Energy
- Fuji Electric
- General Motors
- Gore Fuel Cell Technologies
- Hydrogenics
- Idaho National Laboratory
- Intelligent Energy
- ITM Power
- Johnson Matthey Fuel Cells
- LG Fuel Cell Systems Inc.
- Methanol Institute
- National Renewable Energy Laboratory
- Nebraska Public Power District
- Nissan Technical Center North America
- Nuvera Fuel Cells
- Pajarito Powder
- PDC Machines
- Plug Power
- Proton OnSite
- Sandia National Laboratories
- Savannah River National Laboratories
- SCRA
- Shell Oil Company
- South Coast Air Quality Management District
- The Linde Group
- Toyota Motor North America
- Treadstone Technologies
- Trulite, Inc.
- Volkswagen Group of America