Final Technical Report:

HYDROGEN CODES AND STANDARDS OUTREACH

The National Hydrogen Association

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Submitted by

THE NATIONAL HYDROGEN ASSOCIATION
1800 M Street NW, Suite 300 North
Washington, DC 20036-5802

KAREN HALL, PRINCIPAL INVESTIGATOR

Submitted to
PATRICK DAVIS
Program Manager (Acting)
Hydrogen, Fuel Cells and Infrastructure Technologies
The U.S. Department of Energy

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PROJECT IDENTIFICATION

This project began in August 2001 as Grant # DE-FG-03-00SF22341/A000, and ended in March 2007 as Federal Grant # DE-FG03-01SF22341/A002. The project title was “Hydrogen Codes and Standards Outreach”.

The recipient was the National Hydrogen Association. The Project Director/ Principal Investigator was Karen (Miller) Hall. The work was performed under a Management and Technical Services Agreement with Technology Transition Corporation.

EXECUTIVE SUMMARY

This project contributed significantly to the development of new codes and standards, both domestically and internationally. The NHA collaborated with codes and standards development organizations to identify technical areas of expertise that would be required to produce the codes and standards that industry and DOE felt were required to facilitate commercialization of hydrogen and fuel cell technologies and infrastructure. NHA staff participated directly in technical committees and working groups where issues could be discussed with the appropriate industry groups. In other cases, the NHA recommended specific industry experts to serve on technical committees and working groups where the need for this specific industry expertise would be on-going, and where this approach was likely to contribute to timely completion of the effort.

The project also facilitated dialog between codes and standards development organizations, hydrogen and fuel cell experts, the government and national labs, researchers, code officials, industry associations, as well as the public regarding the timeframes for needed codes and standards, industry consensus on technical issues, procedures for implementing changes, and general principles of hydrogen safety. The project facilitated hands-on learning, as participants in several NHA workshops and technical meetings were able to experience hydrogen vehicles, witness hydrogen refueling demonstrations, see metal hydride storage cartridges in operation, and view other hydrogen energy products.

PROJECT RESULTS – COMPARISON OF ACTUAL ACCOMPLISHMENTS WITH THE GOALS AND OBJECTIVES OF THE PROJECT

The NHA performed work in two areas: Technical conference/meeting support and Support for US Model Codes. Over five years the tasks grew to reflect the changing landscape of related activities. Activities included, but were not limited to, administering technical input for US and international standards, participating directly in active working groups for the standards development organizations for hydrogen and fuel cell technologies and infrastructure, and providing direct as well as indirect support to modify the US model codes to support emerging hydrogen and fuel cell technologies. Specific project results are detailed below.

Task 1. Technical Conference Support

This task covered three basic areas:

1.a. Workshops: The NHA held technical conferences with industry, academia, national laboratories, government laboratories, code officials and code organizations to bring experts together in a focused activity to develop and write new standards for hydrogen technologies. This included such items as storage tanks, fueling nozzles, connectors, safety equipment, and other key components and integrated systems needed to move hydrogen into the energy sector.

1.b. ISO TC 197 Participation: The NHA has members and staff who have been active participants in the International Standards Organization and its Technical Committee 197, which is responsible for the presentation and approval of the developed standards in the international arena.

1.c. Other Related Activities: This covered other activities that support the project, such as developing industry consensus on priorities, coordinating efforts with related organizations, and participating in safety-related workshops, seminars, and conferences.

Objectives:

- To provide a forum for issues, to present consensus hydrogen industry input domestically and furnish a collective U.S. hydrogen industry position at international meetings.

- To present the U.S. hydrogen positions at international forums and participate in international meetings that are of benefit to the whole hydrogen community in the areas of hydrogen safety, codes and standards.

The primary focus of these activities has been the development of national and international standards that promote the safe use of hydrogen in systems and components, as well as activities that encourage the increased use of hydrogen. Organizations with which the NHA coordinated include the International Organization of Standardization (ISO), the International Energy Agency (IEA), the International Electro-technical Commission (IEC), the Society for Automotive Engineering (SAE), CSA International, the Compressed Gas Association (CGA), and the U.S. Fuel Cell Council (USFCC). The NHA provided appropriate technical and safety information to these organizations through presentations, publications, and by creating opportunities to meet and discuss common interests.

Approach: Participate in relevant meetings, including hydrogen-specific and broader energy-related meetings and conferences. Present U.S. hydrogen community position at these meetings through formal and informal forums. Attend ISO/TC-197 work group meetings, plenary sessions, and other applicable meetings.

Key Groups and Results: The NHA participated in dozens of coordination meetings with codes and standards development organizations, researchers, and industry:

- **National Fire Protection Association's (NFPA) Hydrogen Coordinating Group**;
    - The NHA supported NFPA efforts to address hydrogen energy technologies in NFPA codes. Specific support included:
        - reviewing and announcing a new NFPA book on industrial gases
        - submitting comments on NFPA plans to create a new Technical Committee for hydrogen technologies
        - attending code hearings
        - speaking in support of code change proposals
        - contributing to setting priorities for the National Fire Protection Research Council
        - serving on two NFPA Technical Committees directly.
- **National Hydrogen and Fuel Cells Codes and Standards Coordinating Committee**;
    - The NHA was a founding member of this group.
        - The NHA prepared proceedings of In-person meetings, drafted minutes and conducted meetings when requested.
        - The NHA contributed topics for discussion, posted minutes and proceedings in *The Hydrogen and Fuel Cell Safety Report*
        - The NHA Maintained webpages for use by the Coordinating Committee.

Other Key meetings and results are described in further detail in the applicable section below.

- SAE Fuel Cell Standards Committee;
- SAE Interface Working Group;
- SAE Hydrogen Quality Task Force;
- Hydrogen Ad Hoc Committee of Michigan's Department of Environmental Quality, Waste and Hazardous Materials Division (WHMD);
- NFPA Fire Prevention Conference;
- SAE, US and ISO TC 197 WG 12 meetings on hydrogen fuel quality specifications;
- ICC ad hoc Committee on Hydrogen Gas (now the Hydrogen Industry Panel on Codes, which is a virtual entity, not one of the ICC);
- ICC code development committees.

Elements of the NHA's technical conference support included NHA workshops, ISO TC 197 participation, and other related activities, as described below.

Task 1.a. NHA Workshops

The NHA holds workshops in conjunction with technical conferences where industry, academia, national and government laboratories, code officials, code organizations, and other stakeholders can come together to identify hydrogen safety code and standards issues and work on drafting consensus documents. Eleven Workshops were held during the contracting period, reaching well over 500 people.

September 2001
An NHA Hydrogen Safety Codes and Standards Workshop was held in September 2001 at the Wyndham Hotel in Washington, DC. There were forty-five participants from academia, government and industry and included NHA members as well as non-members. There was no fee charged for the two-day workshop.

February 2002
The NHA held a Hydrogen Codes and Standards Safety Workshop on February 26, 2002 in Hilton Head Island, South Carolina. The NHA Workshop was held in conjunction with NHA member Savannah River Technology Center's Hydrogen Storage Workshop. There were thirty-seven attendees both NHA members and non-members, ranging from large industry leaders and smaller hydrogen technology developers to public transit agencies, utility companies and national labs. There was no fee charged for the Workshop. Proceedings are available at www.hydrogenandfuelcellsafety.info.

September 2002
The Workshop was held in Fort Worth, Texas on September 30, 2002 in conjunction with the ICC Final Action hearings. The goal was to gain increased code official attendance so that education on hydrogen issues could occur. There were fifty registered attendees including numerous code officials from districts all over the country. The Proceedings of the meeting were published in the October issue of the *Hydrogen and Fuel Cell Safety Report (http://www.hydrogensafety.info/archives/2002/oct/4.html)*. Proceedings include agenda, attendee list, and presentations given during the workshop. During this workshop the NHA codes and standards committee developed a list of issues that they believe that NHA should focus on in 2003. The list was then vetted by the membership in a polling process and those items that received the most interest were pursued by the committee.

May 2003
On May 30, 2003, the day following the Fuel Cell Summit, NHA staff prepared and conducted an NHA Hydrogen Safety, Codes & Standards Workshop. To stimulate new growth and activity the NHA formed new working groups and selected Chairmen. Staff invited participants to suggest other stakeholders who may have an interest in the activity. Staff followed up with these stakeholders and invited them to join the working group, or provide assistance to the working group. Working groups formed covered the following areas:

- National and International Regulations for Hydrogen Storage
- Global Technical Regulations
- DER Road Shows
- CSA support of NGV revisions for H2 tanks
- Portable power coordination
- Support NFPA Hydrogen Coordinating Group:
- Coordination activities with SDOs, others

The ½ day workshop concluded with a ride-and-drive demonstration of General Motors' HydroGen3. GM, a sponsor for the workshop, made available their fuel cell powered minivan for driving opportunities around the conference facilities and neighboring streets.
For the ½ day immediately following the NHA Codes and Standards Workshop, staff organized and participated in a KnowH2OW Hydrogen Short Course conducted by Air Products and Chemicals.

November 2003: Handling Hydrogen Short Course:
The NHA held a short course on handling hydrogen safely in conjunction with the 2003 Fuel Cell Seminar on November 3rd at the Fontainbleau Hilton Hotel in Miami Beach, Florida. The short course was taught by hydrogen experts representing production, storage, delivery and utilization.

The course offered an introduction to basic hydrogen safety issues, including a comparison to other fuels. In addition, the Handling Hydrogen Short Course focused on the technical considerations for improving and maintaining hydrogen safety in developing applications like refueling stations and hydrogen dispensers.

Topics included:

- improved safety through dispensing operations;
- the relationship between hydrogen production and purity;
- materials selection considerations;
- hazards analysis for hydrogen refueling stations and aerospace technologies; and hydrogen storage technologies.

April 2004
The NHA announced and held a Hydrogen Safety, Codes and Standards Workshop on Thursday, April 29, 2004 immediately following the conclusion of the NHA's 15th Annual Hydrogen Conference and Hydrogen Expo US. The Workshop was free and open to all interested parties, and was held at the Renaissance Hollywood Hotel.

In addition to updates from the NHA working group activities, topics discussed include US Model Codes – Hydrogen Activities, the new Regulators Guides for Permitting, Hydrogen Purity Specifications, Hydrogen Detection Methods, and an update on the availability of the Hydrogen Codes and Standards Matrix which can be found at: http://www.hydrogensafety.info/archives/2004/may/1.html.

September 2004: Hydrogen and Fuel Cell Vehicles in Your Neighborhood: A Southern California Community Workshop
On September 16, 2004, the National Hydrogen Association and the California Fuel Cell Partnership teamed together to create "Hydrogen and Fuel Cell Vehicles in Your Neighborhood: A Southern California Community

Workshop." The workshop, free to attendees, targeted emergency responders, safety officials, public servants and others with introductory hydrogen and fuel cell information in the morning followed by technical subjects in the afternoon with emergency response training and hydrogen station citing permitting experiences. During lunch, attendees had an opportunity to get behind the wheels of the latest suite of hydrogen fuel cell vehicles from DaimlerChrysler, Ford, GM, Honda, Hyundai, Toyota and Volkswagen in conjunction with the CaFCP's Road Rally and experience vehicle fills at the new hydrogen station on site at the South Coast Air Quality Management District in Diamond Bar, CA.

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Of almost 100 attendees, emergency responders comprised 25% and another quarter included city and regional planners, code officials and public works representatives. The balance was comprised of community and industry representatives and other interested parties.

In their evaluation responses, most asked for more information and workshops. "More workshops and more often," requested one attendee. Considering that the same respondents ranked the presentations better than 8 out of 10 and all said the content was useful, the request for more hydrogen information stood out clearly. Attendees requested information on a variety of topics showing that these audiences need information in all sectors; however, technical information like "fire suppression operations," "details concerning hydrogen generation and delivery systems," and tools describing code development and permitting processes were the most abundant. Not surprisingly, emergency responders also specifically wanted handouts describing emergency response practices for stations and vehicles.

In the latter part of the workshop, an informal afternoon poll showed that almost every emergency responder attended the workshop because they need to evaluate and approve hydrogen installations in their jurisdiction today. With more and more hydrogen projects announced each month, this result underscores the need to educate and familiarize local officials before planned projects become a reality.

November 2004: Implementing Hydrogen Energy Systems

The National Hydrogen Association conducted a half-day workshop on hydrogen, titled: Hydrogen Workshop: Implementing Hydrogen Energy Systems, on Monday, November 1, 2004 in conjunction with the Fuel Cell Seminar in San Antonio, Texas. The workshop built on the success of the 2003 Workshop by including more case studies of experiences in siting hydrogen energy projects. Over 40 participants heard case studies from industry leaders including Air Products & Chemicals, ChevronTexaco, and BOC Gases, as well as technical presentations on validation activities for hydrogen release characterization and guidance available to assist with permitting fuel cells and hydrogen refueling stations. In addition, participants learned about a new certification program for hydrogen specialists.

The overall response for the workshop was good, with a number of participants indicating interest in more case studies, more information about hydrogen codes and standards, and general information on requirements to implement hydrogen energy systems. Participants received e-mail notification for the Hydrogen Safety Report, where these topics are being addressed. Participants were also invited to register for future NHA Hydrogen Safety, Codes & Standards Workshops, which typically cover these topics in more detail. In addition, the evaluation results were used to tailor a proposal to hold another workshop at the Fuel Cell Seminar in 2005.

November 2005

On Monday November 14, 2005 in Palm Springs, California, the National Hydrogen Association held a hydrogen workshop entitled "Understanding Hydrogen Energy Technologies" in conjunction with the 2005 Fuel Cell Seminar. This workshop covered the current state of hydrogen energy technologies and the application of codes and standards that relate to them.

National Hydrogen Association member experts and invited guests presented technical data and case studies to:

- provide the state of key technologies, including hydrogen fuel, hydrides, electrolysers, and storage and dispensing equipment;
- give insight into how hydrogen equipment is permitted;
- describe the ever-changing U.S. model codes that pertain to hydrogen technologies, including fuel cells; and
- provide technical resources the audience can use beyond the workshop to keep abreast of changes in the areas discussed in the workshop.

Presentations are available at http://www.hydrogenandfuelcellsafety.info/archives/2005/nov/nhaWorkshop.asp.

September 2006: ICC Educational Workshops

During the Code Development Hearings for the International Code Council, the National Hydrogen Association hosted two morning workshops focused on hydrogen education at the Disney Coronado Springs in Orlando, Florida, September 21-22, 2006.

At the early breakfast workshops titled "Wake Up to Hydrogen," approximately 50 attendees (including code and permitting officials with some hydrogen industry professionals) engaged the speakers in questions and took the opportunity to examine the fuel cells and hydrogen storage devices. Jadoo Power had several of their metal hydride hydrogen canisters and fuel cells on hand for inspection. On both days, their N-Gen fuel cell operated the laptops during the workshop. Jadoo Power representatives also showed attendees examples of bonfire- and overpressure-tested metal hydride canisters to show that the containers maintain their structural integrity even when brought to failure.

Many different topics were covered during the workshop, but the main focus was on technical topics related to the ICC hydrogen code proposals. The main technical topics addressed were:

- Indoor fast-fill fueling (> 12 SCFM) today, mainly for fueling lift trucks, pallet trucks and other equipment in large warehouses
- Above-ground liquid hydrogen storage including diking, flash losses and liquid hydrogen's inability to pool if spilled
- Hydrogen storage for telecommunications including how hydrogen can be safely stored in cabinets near telecommunications equipment
- Fueling station overpressure protection which when located on a dispenser hooked up to a vehicle (one connected system) can provide an extra layer of safety to protect the vehicle's hydrogen tank from being overfilled

Presentations from the workshops, as available, are located online at
http://www.hydrogenandfuelcellsafety.info/resources/workshops/06sep/index.asp

November 2006

On November 13, 2006, the NHA held the workshop, "Hydrogen Energy Technologies - Safety, Installations, and Permitting," in conjunction with the Fuel Cell Seminar. The workshop was a focused ½-day workshop aimed at technical individuals who wanted to learn more about hydrogen energy technologies and the application of codes and standards that relate to them.

The interactive workshop which featured lots of questions from attendees also included the opportunity to handle some portable fuel cell and refueling systems (courtesy of Jadoo Power) and metal hydride canisters that had been bonfire and overpressure tested. The latter showed that even when brought to failure, hydrogen canisters will safety maintain their structural integrity. Workshop presentations are available at:
http://www.hydrogenandfuelcellsafety.info/h2techWorkshop.asp.

The workshop was attended by 36 professionals. In addition, the visibility and use of the presentation material through the *Hydrogen and Fuel Cell Safety Report* has been significantly greater. In the 5 weeks after the workshop, speakers' presentations were downloaded over 3,000 times.

Task 1.b ISO TC 197 Participation

NHA staff has accepted a very active leadership role in ISO TC 197, the International Standards Organization Technical Committee for Hydrogen Technologies. Active participation in ISO TC 197 ensures that US interests are considered in the development of international standards. NHA participation also facilitates information exchange with industry regarding technical issues arising in the work items of this technical committee. NHA staff has served as head of the US delegation in the annual plenary meetings. In addition, Mr. Bob Mauro was named the Chairman of the U.S. Technical Advisory Group for ISO TC 197 while he was serving as the Executive Vice President of the NHA. Duties of a U.S. TAG Chairman are as follows:

- Work with the U.S. TAG Administrator to coordinate U.S. TAG positions
- Coordinate meetings
- Take a lead role in bringing U.S. interests to ISO
- Lead in identifying potential members of the U.S. TAG

Karen (Miller) Hall has been an active member of the drafting committee for the past five plenary meetings. This committee, comprised of Ms. (Miller) Hall and the Secretariat, is responsible for drafting the resolutions of the meeting. In September, Ms. (Miller) Hall was named to the ISO TC 197 Permanent Editing Committee. Duties include:

- Update and edit committee drafts (CD), enquiry drafts (DIS) and Final Draft International Standards (FDIS) considered at meetings or circulated between meetings;
- Ensure their conformity with Part 3 of the ISO/IEC Directives;
- Ensure the equivalence of the texts in the official languages.

ISO TC 197 working groups which NHA staff supported are as follows:

- ISO TC 197/WG 5; Gaseous hydrogen blends and hydrogen fuel — Service stations and connectors
- ISO TC 197/WG 6; Gaseous hydrogen and hydrogen blends — Land vehicle fuel tanks
- ISO TC 197/WG 7; Basic considerations for the safety of hydrogen systems
- ISO TC 197/WG12; Hydrogen Fuel Quality
- ISO TC 197/WG13; Hydrogen Detectors

NHA staff participated directly in working groups, was active in the US Technical Advisory Group (TAG), and served on the Permanent Editing Committee of ISO TC 197. In addition, the NHA kept stakeholders informed of activities through direct e-mails, conference and workshop presentations, and by providing regular updates online in the *Hydrogen and Fuel Cell Safety Report*. Bob Mauro, who was a member of the NHA staff at the beginning of this project, served as the Chairman of the US TAG for ISO TC 197, and head of the US delegation at the international plenary meetings.

The NHA developed requirements for documents that were then submitted to ISO TC 197 for consideration. When this project started, national standards development organizations were not prepared to develop or publish standards for hydrogen energy technologies. NHA members indicated a need for hydrogen technology standards to meet commercialization timeframes. As national standards development organizations were not pursuing hydrogen standards, broader consensus and publication could occur only in ISO TC 197. During the performance

of this project, national standards development organizations have received the support they needed from DOE, the National Labs, and industry to work toward US consensus in advance of international standards. Because of this, the NHA became more involved in national efforts in the second half of the project period of performance.

An example of success in developing a standard requested by industry follows: The NHA maintained a Working Group on Tanks and Containers. This group developed a new work item proposal for ISO-TC-197 on metal hydride storage containers. The working group worked closely with the Department of Transportation to understand existing regulations for the transport of hydrides. The Department of Transportation issued a letter to the NHA and an article was prepared and disseminated to the NHA membership. The work item was approved by ISO TC 197, and a draft Technical Specification was subsequently published. ISO TC 197 is currently developing a draft international standard on this subject

- The NHA kept stakeholders informed of key international efforts by posting items to the NHA members' only website when the items were protected by copyright, and posting the items publicly otherwise.

Staff responded to numerous calls and emails on the status of ISO activities, as well as information about how to get published documents.

The NHA participated in all US TAG meetings of ISO TC 197, as well as the Plenary meetings, during the contract period of performance, contributing to discussions and decisions, and keeping interested parties informed of activities.

The 2005 Plenary meeting for ISO TC 197 was held on November 10, 2005 in Palm Springs, California, in conjunction with the 2005 Fuel Cell Seminar. ISO TC 197 WG12, the working group on hydrogen quality, also met. Karen Hall, NHA staff, participated in both meetings, and disseminated information through the *Hydrogen and Fuel Cell Safety Report.*

The ISO TC 197 Chairman reported on his activities to promote TC 197 by means of a round table in early 2007 for facilitating global harmonization of regulations, codes and standards on hydrogen and other gaseous fuels, infrastructure as well as road and off-road vehicles that use these fuels. He has been named to manage the development of the roundtable. The NHA published additional information in the *Hydrogen and Fuel Cell Safety Report* as it became available, and attended the Roundtable.

WG12: Hydrogen Fuel Quality: Karen (Miller) Hall also participated in the Working Group 12: Hydrogen fuel — Product Specification meetings. The NHA participated in several teleconferences to prepare the North American position on the ISO draft Technical Specification for hydrogen fuel. In addition, NHA staff drafted a white paper on nozzle contamination for fuel quality, and subsequent language to resolve issues raised by one automotive manufacturer.

Working Group 12 was created as a result of a Japanese proposal to create a hydrogen fuel grade for PEM fuel cell vehicles, based on data developed by the Japanese Automobile research Institute (JARI). The data represented an excellent start at beginning to quantify the effects of impurities on PEM fuel cells that many automotive manufacturers plan to use in fuel cell vehicles. The data, however, was limited to short-term testing and analyses only some specific impurities on two types of fuel cell membranes.

The Draft International Specification was finalized and sent to TC 197 for vote. The NHA solicited industry input on the related documents.

WG13 - Hydrogen Sensors: NHA staff has been participating in the development of a Japanese-led activity to develop a new ISO standard for hydrogen-specific detection devices, primarily for use for large stationary

applications, such as refueling stations. The first draft was prepared for distribution to the Technical Committee. It has not yet been distributed by the ISO TC 197 Secretariat.

Task 1.c. Other Related Activities

NHA Role in setting National Priorities for Codes & Standards:

NHA staff participated in the Department of Energy National Hydrogen Roadmap Workshop on April 2-3, 2002 to identify issues surrounding safety codes and standards for hydrogen energy systems. A story on the workshop entitled "Codes and Standards – Pervasive Theme at DOE National Hydrogen Energy Roadmap Workshop" was written and included in the April edition of the *Hydrogen and Fuel Cell Safety Report.*

The National Hydrogen and Fuel Cells Codes & Standards Coordinating Committee:

In the past, there have been several organized hydrogen and/or fuel cell codes and standards coordinating activities that addressed coordination of codes and standards development efforts across various CDOs and SDOs and for various applications. Three such organized efforts are as follows:

- DOE Hydrogen Codes and Standards Coordinating Committee (HC&SCC)
- USFCC Codes and Standards Working Group
- NHA Hydrogen Safety, Codes and Standards Committee

For the past several years, the DOE HC&SCC and the USFCC C&S Working Group have been successfully conducting joint monthly meetings. The NHA has been involved with the DOE HC&SCC since inception. The three organizations consolidated their efforts into a single entity that is called the National Hydrogen and Fuel Cells Codes and Standards Coordinating Committee (NHFCCSCC).

This increased coordination helps reduce duplication of effort, and provides a mechanism for more timely information exchange, benefiting the national effort. The NHA worked with the National Renewable Energy Laboratory and the Department of Energy to form the NHFCCSCC. NHFCCSCC meetings were held at the NHA office on August 15 and November 27 of 2001.

The NHA was funded under a separate subcontract through NREL to cover additional administrative costs associated with NHFCCSCC meetings and teleconferences, and to publish the *Hydrogen and Fuel Cell Safety Report*.

A codes and standards matrix was developed during the first meeting on August 15, 2001. This matrix was developed further, and is currently maintained by Kelvin Hecht at www.fuelcellstandards.com. The NHA continues to promote this website and the matrix.

NHA staff attended the NHFCCSCC meeting at the University of Maryland on May 31, 2002. Major topics of discussion included planning for final action hearing in late September, the codes and standards matrix, and near-term C&S needs.

A quarterly National Hydrogen and Fuel Cells Codes and Standards Coordinating Committee (NHFCCSCC) meeting was held at the NHA office on March 7 and 8, 2003.

The NHA co-hosted and participated in a two day workshop of the NHFCCSCC in Washington, DC in preparation for the ICC Final Action hearings.

The NHA also hosted and participated in the NHFCCSCC's in-person meeting on harmonization on March 7, 2003 and wrote a draft of an article on the meeting results for the April edition of the Hydrogen Safety Report.

The joint In-Person March/April meeting of the DOE Hydrogen Codes and Standards Coordinating Committee, the USFCC Codes and Standards Working Group and the NHA Codes and Standards Committee was the National Codes & Standards Workshop for Hydrogen and Fuel Cells. The Workshop was convened by NHA in conjunction with its 2005 16th Annual Hydrogen Conference and Hydrogen Expo in Washington, DC during the period March 29 - April 1, 2005. There were 90 participants.

The NHA helped plan and conduct a workshop, which was an In-Person meeting of the National Hydrogen and Fuel Cells Codes & Standards Coordinating Committee. U.S. codes and standards experts met in Long Beach, California in conjunction with the 2006 NHA Annual Conference on March 15. This was an opportunity for National Standards Development Organizations and the U.S. experts to discuss issues of common interest. This meeting was hosted by the NHA. 49 people participated in-person or by phone.

NHA Involvement in other Related Conferences and Meetings:

The NHA presented at dozens of related conferences and workshops. Formal papers, when presented, were submitted to DOE in the quarterly technical report that covered the period of performance.

The NHA worked with the World Hydrogen Energy Conference (WHEC) to develop the codes and standards session at the conference. WHEC was held June 9-14, 2002. Ms. (Miller) Hall co-chaired a session and presented a paper on SAE fuel cell vehicle standards on behalf of Ron Sims. She also attended technical sessions on hydrogen safety codes and standards.

Ms. (Miller) Hall wrote two papers and gave separate presentations on each at the 2002 Global Powertrain Congress Conference in Ann Arbor, Michigan September 24-26, 2002. The papers dealt with Hydrogen Codes and Standards. The papers and presentations were provided to DOE under the quarterly report that covered this period.

Ms. (Miller) Hall gave a presentation on hydrogen separation distances used in developing codes and standards to the American Institute of Aeronautics and Astronautics Joint Propulsion Conference. She presented at the conference in July 2002. The presentation was delivered to DOE.

NHA staff worked closely with Air Products and Chemicals to offer a pre-conference workshop on hydrogen safety, in conjunction with the NHA's Annual Conference and Exhibition in March 2003. The workshop covered various topics including Hydrogen properties, Modern approach to safety, hydrogen production and applications, gaseous and liquid hydrogen safety concerns vehicle and hydrogen fueling considerations and codes and standards. The workshop was held on March 4, 2003 and was filled to capacity. An article on the workshop was published in the March edition of the Hydrogen Safety Report.

Staff also prepared and submitted a presentation on hydrogen safety for the FUSYS2 Conference in 2003. This paper was delivered to DOE.

Ms. (Miller) Hall, Mr. Serfass and Mr. Hester participated in the DOE Fuel Cell Summit on May 28 & 29, 2003. Ms. (Miller) Hall presented an update of ISO TC 197 activities, based on input from the ISO TC 197 Secretariat, Sylvie Gingras, and Chairman, Randy Dey. A copy of this presentation is attached.

On November 7, 2003, the National Hydrogen Association and the U.S. Fuel Cell Council jointly hosted a meeting of 15 representatives from government and the various U.S. Technical Advisory Groups (TAGs) involved in international standards relating to hydrogen and fuel cells. Representatives from the U.S. DOE and EPA, along with representatives from ISO TC 22 SC 21, ISO TC 197, ISO TC 58, ISO TC 11, and IEC TC 105, took the opportunity to meet each other and discuss issues of common concern within their TAGs regarding hydrogen and fuel cells. Tony Androsky and Karen Hall welcomed participants on behalf of the USFCC and the

NHA, and stressed the importance of having developed a national consensus in advance of the international meetings. The NHA and USFCC hope to keep the dialogue going beyond this meeting.

The National Renewable Energy Laboratory held a workshop on Monday April 26, 2004 in advance of the NHA's 15th Annual Conference and H2 Expo USA to bring together stakeholders to discuss the activities, objectives, scopes, and timetables of the various efforts. The purpose of the workshop included the following:

1. to gain a better understanding of who is doing what in developing fuel purity guidelines and standards in terms of objectives, definitions, scope, timetable, and participants
2. to develop a rough work breakdown structure of the fuel purity issue for the total "fuel cycle" for which purity requirements must be defined, including
    a. levels or tiers required for fuel purity corresponding to each segment of the fuel cycle
    b. criteria to develop technically sound and economically viable guidelines or standards
    c. R&D needed to define the levels of purity appropriate for each level or tier
    d. timetable for the guidelines and standards
    e. a rough budget for R&D and guideline/standard development.
    f. cost of analysis to ensure purity level at each segment of the fuel cycle

The NHA provided meeting room space, contributed to the agenda, and ensured a broad array of stakeholders would be invited to this workshop.

US TAG TEAM Meetings: US Experts involved in the development of codes and standards for hydrogen and fuel cell systems met in Troy, Michigan at the SAE Automotive Headquarters on December 6 & 7. This was the third US TAG TEAM meeting, an opportunity for National Standards Development Organizations and the US Technical Advisory Groups (TAGs) for ISO and IEC Technical Committees to discuss issues of common interest. The meetings are supported jointly by the US Fuel Cell Council and the National Hydrogen Association and provide an opportunity to discuss issues impacting US interests in the ISO and IEC standards-development working groups, as well as UN activities on regulations for hydrogen energy systems. By discussing issues our TAGs face individually, stakeholders can discover where these issues impact other areas and try to build US consensus in a broader context.

Support of National Efforts:
NHA staff has participated directly in meetings of national standards development organizations, and have recommended industry experts on specific topics as required.

Ms. (Miller) Hall voted in favor of an SAE work item on recyclability for acceptance of draft recommended practice.

Staff met with CSA America to discuss continued needs in hydrogen technology standards, and to determine areas of mutual concern. Several articles on CSA America were published in the Hydrogen Safety Report including:

- National Standard for Hydrogen Containers
- Update: CSA America Releases Drafts of their American National Standard for Comments

Staff attended a meeting on Natural Gas Vehicle on-board storage tank standards as a basis for hydrogen standards in Cleveland, Ohio, held by CSA America.

Staff also reviewed SAE calendar for future meetings of interest and included relevant meetings on hydrogen safety events calendar at www.hydrogenandfuelcellsafety.info. This review ensured that the 2004 NHA Annual Conference would not occur during a key SAE conference.

Staff attended a meeting at DOT to discuss regulations for micro fuel cells and their fuels. Discussions took place on how micro fuel cells could be approved and shipped.

The NHA supported the efforts by NREL to develop a national template for the development of hydrogen-related codes and standards for various applications. One of the key near-term activities was to establish licensing agreements with CDOs and SDOs that the DOE Hydrogen, Fuel Cells and Infrastructure Technologies Program can utilize to make the latest versions of hydrogen-related codes and standards documents available (via the web) to a "DOE User Guest List." Initially, the focus will be on building code and fire safety officials. The objective of this activity is to facilitate the permitting of hydrogen projects--insuring that they are not delayed because permitting officials do not have the codes and standards needed for use in the permitting process. The NHA participated in meetings and telecoms relating to this event, and included the topic at NHA codes and standards workshops.

The California Fuel Cell Partnership generated a document "Emergency Response Guide for Light Duty Fuel Cell Vehicles" that acted as the starting point for generating a Module for first responders. The NHA worked with the CaFCP to promote this new document, and used it as a reference in subsequent presentations.

Support of International Efforts:

In addition to participating in ISO TC 197 and the International Electrotechnical Committee for Fuel Cells (IEC TC 105) activities, staff presented at a number of international conferences on the NHA activities and priorities in codes and standards.

Ms. (Miller) Hall participated in an IEC-TC-105 meeting in December and volunteered to draft Section 5.6: Automatic Control System, of the standard for Safety of Stationary Fuel Cell Power Plants.

Staff prepared and submitted an abstract on hydrogen codes and standards activities for the 2003 Hydrogen & Fuel Cell Conference, to be held in June 2003 in Vancouver, BC. At the conference, Ms. (Miller) Hall presented a paper entitled: Progress of Creating Codes, Standards, and Regulations for Hydrogen Energy Systems. The presentation described the NHA's interest in codes and standards, and presented the process used in the United States to codify technical requirements. It also described the NHA's role in demonstration activities, including educating permitting authorities, creating outreach materials to facilitate public support, assisting with the application of existing and developing codes and standards to ongoing demonstrations, and feeding lessons learned back into the codes and standards process, to improve safety and performance of future hydrogen energy activities.

Other related activities:

- This project included efforts to coordinate codes and standards activities to avoid duplication of effort and to enable hydrogen systems to be sited. This required coordination with industry groups and standards organizations such as International Standards Organization, American Society of Mechanical Engineers, IEC TC 105, the U.S. Fuel Cell Council, the Society of Automotive Engineers, Fuel Cell Propulsion Institute, and National Fire Protection Association. Articles were developed that suggested ways in which the hydrogen community and other organizations could work together in the future. Articles were disseminated to the NHA membership and the public through the on-line publication Hydrogen Safety Report located at www.Hydrogenandfuelcellsafety.info.

Mr. Patrick Serfass created the NHA's Hydrogen Codes & Standards Organizational Chart. The Organizational Chart is a working document (like the Hydrogen Codes and Standards Matrix) that was originally created for internal purposes and is now available for public use. Its purpose is to provide a quick web link to more information about all groups involved in codes and standards development, while also providing the basic structure of the organizations' working groups, task forces, committees, etc. This document was created in

response to the need to clarify the relationship of the subgroups of SDOs and related organizations and provide a link to the websites of those organizations and subgroups.

Ms. (Miller) Hall drafted, finalized and gave a presentation on the NHA's codes and standards activities funded by the Department of Energy at the Hydrogen Program Peer Review in Golden, Colorado on May 6, 2002. A final paper for the hydrogen Peer Review publication was prepared and submitted in June 2002.

Ms. (Miller) Hall prepared a presentation for Fuel Cell Summit VI held on May 30, 2002 at the University of Maryland. She subsequently attended the summit and gave the presentation on international hydrogen codes and standards activities.

NHA discussed the pending hydride activities of Southwest Research Institute. SWRI was recently awarded a DOE contract for hydride certification and testing work. The NHA briefed SWRI on NHA's hydride activities and began a dialog for including SWRI on upcoming hydride issues.

The NHA met with Anne-Marie Borberly Bartis to discuss the Distributed Energy Resources Roadshow and explore ways the NHA could support the effort. NHA also met with representatives of the Natural Gas Vehicle Coalition to discuss their interest in supporting appropriate hydrogen codes and standards activities.

The NHA responded to a DOE request for support of a meeting with DOT. The NHA provided information to Steve Chalk, Program Manager, in the Office of Hydrogen, Fuel Cells and Infrastructure Technologies, and offered to participate in meeting if desired.

Ms. (Miller) Hall has been using the beta version of Hydrogen Sourcebook 2002 to provide case studies and reference materials in our Workshops and presentations. The Sourcebook is a compilation by Canadian and U.S. experts of some prevailing practices and applicable codes, Standards, guidelines and regulations for the safe use of hydrogen. NHA is also using the Hydrogen Handbook for Building Code and Fire Safety Officials, developed by NREL, to inform code officials and others about the uses of hydrogen in transportation and stationary applications and ensure officials receive consistent information.

Ms. (Miller) Hall developed a hydrogen module to be used in the DER Road show. She presented this module at a Road show during October 2002 in Oregon.

NHA responded to a DOE request to identify potential participants for an Education Plan workshop which included the area of codes and standards. Ms. (Miller) Hall, Jeff Serfass, and Lara Neer participated in workshop in early December 2002. Ms. (Miller) Hall wrote an article on the codes and standards elements of the workshop for publication in the *Hydrogen and Fuel Cell Safety Report*.

Ms (Miller) Hall solicited and reviewed abstracts on hydrogen safety, codes and standards for inclusion in the 14th Annual Hydrogen Conference and Hydrogen Expo US. The meeting was held in March 2003 in Washington, DC.

Ms. (Miller) Hall attended the dedication of a hydrogen/electricity co-production station in Las Vegas, NV on November 15, 2002. The station is a public-private partnership between the U.S. DOE, City of Las Vegas, Air Products and Chemicals and Plug Power. Based on this trip Ms. (Miller) Hall prepared a story on hydrogen safety that was included in the autumn issue of the NHA News, which is available online at www.hydrogenassociation.org.

NHA Staff prepared documents as U.S. input to a technical report being prepared by the Partnership for Advancing the Transition to Hydrogen (PATH). The U.S., through the NHA, is a member of this international

organization. PATH is collecting and analyzing differences and similarities in its member country's national approaches to hydrogen safety codes and standards.

Ms. (Miller) Hall and Mr. Serfass reviewed the trial version of an updated electronic Hydrogen Sourcebook, produced by Canadian company, TISEC. Staff worked closely with the developers at TISEC to make sure that the NHA had a demonstration copy of the program for program managers, project developers, code officials and other stakeholders.

The NHA publicized a four-seminar series by CBINet focusing on regulatory concerns, legal issues, codes and standards for micro fuel cell applications held in early 2004. Each seminar had the same agenda, but was held at four different locations around the U.S. and Canada to provide convenient access.

The CBINet course provides micro fuel cell and fuel developers a thorough foundation on understanding and overcoming key challenges of the regulatory, standards and coding required to manufacture and transport micro fuel cells and their fuels. Participants learn about and discuss addressing of legal and regulatory concerns, standards and installation codes, C&S product and development compliance and transportation and HAZMAT safety issues. Additionally, participants discuss the latest and future issues and how to address their needs to guide product output.

Hydrogen Incident: On August 6, 2004, there was a hydrogen incident at Ballard. The NHA worked with Ballard, Praxair, and DOE to ensure interested parties had access to accurate information regarding the incident, and emphasized that no-one was seriously injured.

DOT Gap Analysis: During April 2006, the US Department of Transportation published the report "Hydrogen Infrastructure Safety Technical Assessment and Research Results Gap Analysis" (DOT-T-06-01, April 2006). The report is the result of a DOT effort to identify gaps in the current hydrogen technology base and to recommend solutions for closing the gaps.

With this report, DOT has provided a starting point for assessing existing regulations, and determining where research is needed to revise existing regulations or develop new regulations, and where amendments may be necessary to enable the hydrogen infrastructure. DOT has identified the status of applicable regulations for hydrogen infrastructure. DOT is actively encouraging stakeholder feedback on its report to assist in prioritizing efforts moving forward.

The NHA has written a report to provide feedback to the DOT using input solicited from NHA members, the U.S. Fuel Cell Council, the DOE's National Hydrogen and Fuel Cell Codes and Standards Coordinating Committee, and other interested stakeholders. NHA's goal is to facilitate an open dialog with DOT and industry at meetings of the DOE Coordinating Committee. Feedback received during and following the September 15, 2006 In-person meeting has been included in the final report, which received endorsement from both the NHA C&S Steering Committee and the USFCC. The report was delivered to DOT in December 2006, and posted at www.hydrogenandfuelcellsafety.info.

Coordination between USFCC and Codes & Standards Activities: Over the course of this project, collaboration between national standards development organizations, US TAGs for international standards development organizations and industry associations relating to hydrogen and fuel cells has grown tremendously. The NHA and USFCC have even worked together to discuss opportunities to coordinate more of our collective C&S activities. SAE documents have been published as ISO documents. Industry experts participate in working groups and technical committees. The NHA continues to encourage open dialog and broad stakeholder input to facilitate adoption of necessary standards to meet commercialization timelines.

Task 2 – US Model Code Support (ICC and NFPA):

The NHA supported both the International Code Council (ICC) and the National Fire Protection Association (NFPA) in their efforts to review, develop and promulgate new codes for the use of hydrogen. This included providing experts, technical reports, data and other information needed by the Code Officials to complete the development of these new codes. The NHA attended scheduled meeting of the ICC Ad Hoc Hydrogen Committee, as well as relevant Technical Committees of the NFPA, and reviewed available materials during the duration of this contract.

Objective:

- Provide hydrogen safety expertise to support the International Code Council in their efforts to review, develop and promulgate new codes for the use of hydrogen.

Approach: The International Code Council Hydrogen Ad Hoc Committee (AHC) held its first meeting at the NHA office in Washington, District of Columbia on 30-31 August 2000. The purpose of the group was as follows: "The development of appropriate, reasonable and enforceable model health and safety requirements that apply to matters germane to the ICC International Codes and affecting or relating to the use of hydrogen in vehicular and portable applications: inclusive of the safeguards that apply to conditions hazardous to life, property or public welfare in the storage, handling or use of hydrogen in the infrastructures (i.e., service stations, parking garages, loading areas and similar uses) that support vehicular and portable applications. Such provisions would serve as a model for adoption and use by enforcement agencies at all levels of government in the interest of national uniformity." The AHC was composed of code officials, designers, industry representatives, and staff of the three code councils for a total of twelve voting members. There were also non-voting advisors and a number are from the NHA membership including the National Renewable Energy Laboratory, Ford, Praxair, and the Gas Technology Institute. The NHA was proud to host the inaugural AHC meeting and continues to support the ICC in their efforts to review, develop and promulgate new codes for the use of hydrogen.

The NHA continued to support the ICC Ad Hoc Committee on Hydrogen by attending meetings, providing data and expertise, reviewing draft code changes, coordinating industry participation, and publicizing the activities.

Results: When this project began in 2001, ICC had an interest in working with industry to develop code change proposals for the I-Codes. A couple of years into the task, NFPA was ready to do the same. By the end of the task, the NHA co-administered, with staff from ICC and NFPA, a Hydrogen Industry Panel on Codes (HIPOC).

The U.S. Department of Energy (DOE), in conjunction with the National Labs and National Code bodies, developed the first modules in a family of documents to aid in the permitting of hydrogen energy systems. The Overview and first two modules of the Regulator's Guides to Permitting Hydrogen Technologies have been published and are available for all interested parties online:

- Regulators' Guide to Permitting Hydrogen Technologies – Overview
  http://www.pnl.gov/fuelcells/docs/permit-guides/overview_final.pdf

- Module 1 - Permitting Stationary Fuel Cell Installations
  http://www.pnl.gov/fuelcells/docs/permit-guides/module1_final.pdf

- Module 2 - Permitting Hydrogen Motor Fuel Dispensing Facilities
  http://www.pnl.gov/fuelcells/docs/permit-guides/module2_final.pdf

The NHA provided information about these Guides in the *Hydrogen and Fuel Cell Safety Report*, as well as in workshop presentations.

The National Hydrogen Association hosted a discussion on the upcoming changes to the U.S. Model Codes to facilitate hydrogen energy systems in the U.S. Model Codes. Experts from the National Fire Protection Association Hydrogen Coordinating Group and the International Code Council (ICC) Ad Hoc Committee on Hydrogen Gas discussed their activities during a panel discussion at the NHA's Annual Conference on April 28, 2004. Experts described the activities, timescale, and issues they are facing within the NFPA and ICC code development activities, and answered questions from the hydrogen and fuel cell industry in the audience.

Both organizations are developing changes to the U.S. Model Codes to permit the installation of hydrogen energy systems. These activities are expected to facilitate the permitting of new hydrogen energy projects and installations, by having guidance for code officials on issues such as installation, separation distances, ventilation, and electrical connection.

ICC Support: Ms. (Miller) Hall attended the ICC hearings held in Cincinnati, Ohio in September 2001. Due to the terrorist acts of September 11, 2001 the Hydrogen session was cancelled.

Ms. (Miller) Hall participated in several coordination committee conference calls and email correspondence to better understand how to support the ICC hearing in April 2002.

Ms. (Miller) Hall prepared to attend the International Code Council (ICC) hearings to be held in April 2002 in Pittsburgh, Pennsylvania. The NHA also notified its membership of the ICC hearings through publication of an ICC press release in the *Hydrogen and Fuel Cell Safety Report*.

Ms. (Miller) Hall drafted an internal rebuttal to several concerns raised by the American Gas Association (AGA) with including hydrogen in the International Fuel Gas Code.

The NHA sent a letter to industry members requesting their support of code changes to be considered at the upcoming ICC hearings. NHA requested that industry show their support by sending a representative to voice their support or by sending letters.

The ICC Code hearings were held for two weeks during April in Pittsburgh, Pennsylvania. Ms. (Miller) Hall made final preparations to attend and participate at these hearings. This included contacting industry representatives to support the hearings in person or via a letter of support. Much time was spent coordinating activities with DOE contractor Al Vasys. Ms. (Miller) Hall also prepared an NHA statement of support for all relevant ICC committees.

During the hearings Ms. (Miller) Hall attended relevant hearings in support of the ICC AHC code change proposals. She also communicated with all interested parties on the status and issues surrounding the code changes. Ms. (Miller) Hall led a discussion during an industry coordination meeting that helped industry representatives understand the hearings process and time allotment for each message/speaker. On the final day of the hearings, Ms. (Miller) Hall participated in a debriefing session with representatives from DOE and NREL.

The NHA wrote several articles on International Code Council issues that were disseminated to the NHA membership and the public through the *Hydrogen and Fuel Cell Safety Report*.

Ms. (Miller) Hall met with Rhone Resch of the Natural Gas Supply Association regarding the opposition of the American Gas Association to the ICC AHC proposals on hydrogen. He agreed to try to be supportive and the NHA invited him to attend a future meeting of the NHFCCSCC.

The ICC Code final action hearings were held in Fort Worth, Texas, October 1-4. Ms. (Miller) Hall attended and participated at these hearings. This included contacting industry representatives to support the hearings and educating industry on the proposed changes. Much time was spent coordinating activities with DOE through the

HCSCC contractor. The NHA worked with DOE to supply informational material and staffing for the ICC Exhibition held on Sunday and Monday preceding the NHA Safety C&S Workshop.

Staff responded to questions from standards development organizations and the public regarding changes to the I-Codes for hydrogen. The code changes and an article describing the significance of them were published previously under this contract, and remain accessible on the Internet at www.Hydrogenandfuelcellsafety.info.

The NHA membership publicly recognized the success of the ICC ad hoc Committee on Hydrogen Gas by presenting Guy Tomberlin, with the NHA Meritorious Service Award for two years of work with the NHA, DOE, industry experts and code officials to develop appropriate changes to include hydrogen in the International Fire Code, International Mechanical Code, International Building Code, and the International Fuel Gas Code.

In the June 2003 edition of the Hydrogen Safety Report, NHA staff announced and listed proposed code changes from the ICC Ad Hoc Committee on Hydrogen Gas to the hydrogen community. These documents were reviewed by subscribers for remaining issues before the ICC Code Hearings held in Nashville, September 5-17, 2003.

The National Renewable Energy Laboratory hosted a meeting of the International Code Council Ad hoc Committee (AHC) on Hydrogen Gas on November 19th and 20th, 2003 in Golden, Colorado.

Participants discussed ongoing work affecting hydrogen modeling and separation distances of interest to the AHC.

Material presented at this meeting formed the basis of public comments submitted to the ICC, in response to comments leading to a recommendation to disapprove proposed changes to the I-Codes during the recent public hearings in Nashville. Those proposals and committee recommendations are available on the ICC website at www.intlcode.org. The public comments were also posted to the ICC site, in advance of the Final Action Hearing.

NHA staff participated in the Code Development held September 5 – 15 in Nashville, TN to modify 2003 Editions of the ICC Codes to address hydrogen safety issues:

- International Fuel Gas Code
- International Fire Code
- International Building Code
- International Mechanical Code.

There were a total of 15 proposed changes to the four codes that related to hydrogen. Eight were proposed by the ICC Hydrogen Ad Hoc Committee and seven by other organizations, including the Compressed Gas Association, the American Petroleum Institute and the American Gas Association. Of the 15 proposals, eight were approved by the Hearing Committees and seven disapproved. With respect to the Hydrogen Ad Hoc Committee, two of their proposals were approved and six disapproved. The NHA published a detailed review of the results, as well as information on how to submit a proposal, at www.hydrogenandfuelcellsafety.info.

A series of Breakfast and Lunch Roundtable Meetings were held during the period May 16 – 20 at the ICC Spring Meeting and Final Code Hearings. They were targeted at fire safety officials -- to facilitate passage of the modifications proposed by the AHC to the International Fire Code (IFC). The project involved conducting five breakfast/lunch roundtable seminars at the Hearings site on three different days prior to the time the IFC changes reach the floor. The proposed changes were discussed during the meetings. The NHA assisted in the development of the Breakfast and Lunch Roundtable Meetings, including creation of an ad targeting code officials, and published in an ICC journal.

The ICC Ad Hoc Committee for Hydrogen Gas indicated that its role to initiate these code changes is nearing completion, and asked the NHA to take on the role of coordinating industry to make future code change proposals and monitor the code development cycle to ensure future changes do not reverse the progress already made in this area.

In preparation for the 2004/05 Final Action Hearings to the International Codes, the NHA held two teleconferences to discuss issues and plan industry support. The NHA Codes and Standards Committee members reviewed material for public comments that were recently submitted on behalf of the AHC for the 2004/05 Final Action Hearings to take place. Those hearings took place from September 25th through October 2nd, 2005 at the COBO Conference and Exhibition Center in Detroit, Michigan. Due to funding constraints, staff did not attend the hearings in person.

The ICC Code Development hearings, held September 20-October 1, 2006 at Disney's Coronado Spring Resort, Walt Disney World®, Florida had mixed results for the 15 code changes relating to hydrogen. Just less than half of the proposals were "recommended for approval" at the Final Action Hearings which are scheduled for May 21-27, 2007 in Rochester, NY. Patrick Serfass from NHA staff was there to support code change proposals developed and endorsed by HIPOC, and to coordinate the ICC Workshops described earlier in this report.

The NHA's support of ICC efforts contributed significantly to the development and adoption of code language in the ICC codes for hydrogen energy technologies.

NFPA Activities: The NHA participated in teleconference meetings of the NFPA Hydrogen Coordinating Group. The key item of interest to the hydrogen community is the NFPA Standards Council consideration of consolidation and coordination of hydrogen provisions in the NFPA codes. To this end, a Technical Correlating Committee (TCC) for Hydrogen Technologies was considered by the Council. The Technical Committees that currently cover various aspects of this topic would continue to have primary responsibility for their subject areas and their existing documents. The proposed Technical Correlating Committee would then be comprised of representatives of the existing affected NFPA Technical Committees and others as appropriate to consolidate and coordinate the material into one cohesive code mainly through the use of extracts from the existing documents. The Standards Council, therefore, solicited input from the affected committees and the public on this proposed new project.

The NHA addressed this topic in several teleconferences with industry participation, and sent e-mails and published articles on this subject. There was no consensus in industry on this issue. It was agreed that it would be beneficial to clarify and harmonize the hydrogen provisions across the NFPA codes. Some industry members were concerned that creating a Hydrogen Correlating Committee may not be the best way to achieve this, and could create more confusion. The NHA indicated the industry views to the NFPA and encouraged anyone interested in commenting on this proposed project to do so in writing directly to NFPA.

NFPA has several existing codes and standards that address the use of hydrogen and hydrogen technologies and a new project NFPA 2 Hydrogen Technologies Code that is under development.

Ms. Hall is a member of two NFPA Technical Committees:

- Vehicular Alternative Fuel
- Hydrogen Technologies (responsible for creating the new NFPA 2)

Ms. Hall attends the Technical Committee meetings, which are typically held twice per year, plus teleconference meetings of the Technical Committee meetings and task groups.

The NHA keeps stakeholders informed through HIPOC activities, as well as through regular updates in the *Hydrogen and Fuel Cell Safety Report*.

HIPOC: To follow-up the success of the ICC's ad hoc Committee on Hydrogen Gas, the NHA helped form the Hydrogen Industry Panel on Codes (HIPOC). Their goal is to extend, and to the best extent practicable, harmonize hydrogen code and standard development activities within the ICC and NFPA such that the proper codes and standards are in place (and stay in place) through the conclusion of the 2007/08 ICC Code Development Cycle (2009 Editions) and the conclusion of the 2009 NFPA Codes & Standards Process. This will coincide with the goal of the U.S. Department of Energy (DOE) to have the appropriate codes and standards in place by 2010 to be able to move to a commercialization decision by 2015.

HIPOC is administered by a staff member from the NHA, ICC, and NFPA. HIPOC holds frequent web-based teleconference meetings. In the first quarter of this panel's activity, much of the focus was placed on changes to the I-Codes since the NFPA standards are up for review later this year or next year. However, Carl Rivkin from NFPA has been present at most calls to help insure that changes proposed to the I-Codes may conform as much as possible to requirements in the NFPA documents or that the new I-Code changes may propagate to the NFPA documents to ensure consistency.

The Hydrogen Industry Panel on Codes held several teleconferences to develop proposals for NFPA codes and to prepare for the Final Action Hearings for ICC. Audio recordings of the meetings (when available) and other info can be found online at: http://www.hydrogenandfuelcellsafety.info/hipoc/index.asp

- Through the Hydrogen Industry Panel on Codes, NHA staff members are currently working with industry on proposals for the current round of NFPA 52 hearings.

The details of proposals are available to the public on the HIPOC section of the *Hydrogen and Fuel Cell Safety Report*.

IMPACT/SIGNIFICANCE

The NHA conducted 11 workshops during the period of performance. These were developed to address specific issues, such as educating code officials, preparing for code hearings, exchanging information among industry sectors, sharing results of risk analysis, developing consensus, and coordinating efforts, as described in Task 1.a. above.

The National Hydrogen Association continues to make progress on the hydrogen safety, codes and standards priorities as identified by its members, and leverages its funds significantly with support from the Department of Energy, and facilitates coordination between codes and standards development organizations.

The NHA continues to provide consensus forums for the broadest range of stakeholders in the developing hydrogen energy economy. It continues to keep its Codes and Standards Workshops open to all interested parties and partnering with groups like the CaFCP to offer specific training when needed. Safety outreach efforts are expanding to include state initiatives. The NHA continues to hold workshops and publish the *Hydrogen and Fuel Cell Safety Report.*

Through workshops, technical sessions at the NHA Annual Hydrogen Conference, presentations at other key hydrogen conferences and codes and standards working group meetings, as well as keeping the hydrogen community informed of activities through the *Hydrogen and Fuel Cell Safety Report*, the NHA continues to provide opportunities for dialog among automotive manufacturers, fuel cell developers, hydrogen suppliers,

component manufacturers, research organizations, standards development organizations, and other interested parties to ensure the broadest range of technical consensus possible.

By working closely with the ICC and NFPA, the NHA has successfully modified US model codes to facilitate permitting of hydrogen energy technologies. In addition, we have successfully created a forum (HIPOC) where representatives from industry, ICC, and NFPA can work together to continue to expand the inclusion of hydrogen technologies into the codes, and ensure that requirements in one code do not conflict with those in another code.

The NHA has also been successful in engaging industry to participate in the development of codes and standards, thereby ensuring US industry interests are considered.