

NASFM-Volpe Partnership on Hydrogen
Hydrogen-Related Activities, Briefings and Expertise
Six-Month Report
May 2009

Prepared by the National Association of State Fire Marshals
Contract # 09-P-80019

Background of Project

The membership of the National Association of State Fire Marshals (NASFM) comprises the senior fire officials in the 50 U.S. States and the District of Columbia. State Fire Marshals' responsibilities vary from state to state, but Marshals tend to be responsible for fire safety code adoption and enforcement, fire and arson investigation, fire incident data reporting and analysis, public education and advising Governors and State Legislatures on fire protection. Some State Fire Marshals are responsible for state fire fighter training, hazardous materials incident responses, wildland fires and the regulation of natural gas and other pipelines. State Fire Marshals also provide a link to local fire departments and state and regional fire service associations on safety issues, communication of fire policy, and other topics of common interest. NASFM works with industry, organized labor, the scientific and technical community, standards organizations, the insurance industry, law enforcement, and environmental protection and worker safety authorities and regularly brings these diverse communities together to improve public safety.

To support the Federal Government's commitment to the development of and transition to hydrogen as an alternative fuel to reduce our nation's dependence on foreign oil and provide for a more sustainable future, the National Association of State Fire Marshals (NASFM) has worked with the US Department of Transportation's Research and Innovative Technology Administration (DOT RITA) and the U.S. Department of Energy (DOE) on educational projects that took two tracks: 1) ensuring that code enforcement officials are prepared to deal with the permitting and inspection of hydrogen infrastructure; and 2) ensuring that emergency responders are prepared to recognize and safely respond to incidents involving hydrogen.

NASFM is an ideal organization to deliver this education because it is a neutral entity whose only interest is to facilitate the transition to alternative fuels by ensuring the safety of the public and emergency responders. As we have observed with the safety of liquid and gas pipelines, nuclear energy generation, LNG terminals and other energy infrastructure, the public and its elected officials rely heavily on public safety officials for assurances that technologies and energy infrastructure remain sufficiently safe and secure. Emergency planners and responders have the additional need to ensure their own safety during incidents.

Among other things, NASFM serves as a resource for the State Fire Marshals to help facilitate enhanced public safety in their respective states. Because NASFM's members in most cases are appointed by the Governors or other statewide elected officials, NASFM is in a unique position to influence policy aimed at ensuring an orderly and safe transition to hydrogen. The responsibility within their respective states for code enforcement, plan review, permitting, investigations and, in many cases, responder training, clearly places State Fire Marshals at the center of focus in the transition to alternative fuels, including hydrogen.

Although primary government-funded support for NASFM's hydrogen-related projects ended in 2008, NASFM has continued to conduct limited activities to address hydrogen

code-related issues. This report provides the Volpe National Transportation Systems Center of DOT RITA with an update on those activities and recommendations for future activities to support the Government's ongoing promotion of hydrogen as an alternative to fossil fuels. The State of Work under NASFM's Contract # 09-P-80019 with the Volpe Center requires 6-month and 12-month written reports that comprise the following topics:

- Activities conducted to date through the Hydrogen Executive Leadership Panel (HELP), an organization formed by NASFM to bring together emergency responders, government regulators, scientists, consumers and experts from the automotive and energy industries to facilitate a safe and orderly transition to hydrogen as an alternative fuel source;
- Current activities to educate fire and building code officials regarding hydrogen fueling stations and telecommunication towers using hydrogen as the backup power supply;
- Demonstration of a code official database that identifies adopted codes and contact information for each jurisdiction;
- Update on training resources being developed or adopted as part of the NASFM hydrogen transition program;
- (12-month report only) Outline of what is needed in the way of next steps to ensure code officials and emergency responders are adequately prepared for the safe and orderly introduction of hydrogen in their communities.

History of NASFM Activities on Hydrogen-Related Issues

Hydrogen Executive Leadership Panel (HELP)

In mid-2004, DOT RITA (then the Research and Special Programs Administration) sought the assistance of NASFM in helping to involve emergency responders in the transition from fossil to hybrids, hydrogen-fueled autos and other alternative energies. In response, NASFM created the Hydrogen Executive Leadership Panel (HELP) with the goals of training emergency responders, helping to develop codes and standards to support a successful and safe transition to hydrogen, and helping to build public acceptance of alternative energy technologies. In order to make this possible, HELP took on the task of demonstrating to code enforcement officials and emergency responders that the risks associated with and inherent to these fuels can be mitigated safely.

HELP brought together these code enforcement officials and emergency responders with government regulators, scientists, consumers, and experts from the automotive and energy industries to identify and fulfill education and training needs. The Panel also addressed how fire officials could work with government, industry, and community groups to facilitate and ensure the safety of hydrogen transport, storage and distribution, and the safety of vehicles and the surrounding environment.

In addition to the primary HELP members, the Panel established two advisory committees: the Safe Energy Emergency Response Advisors, which consisted of experts representing state and local emergency responders, industry experts, planners and safety

and training officials; and the Safe Energy Science Advisors, which consisted of engineers, scientists and other technical experts.

HELP met seven times between October 2005 and November 2007 and set out to achieve an ambitious agenda. Among the projects defined by HELP were the following:

- a standardized safety training curriculum on alternative fuels including hydrogen for emergency responders;
- a plan for a community hydrogen education program for use by emergency responders and code officials in their briefings of community leaders;
- a standardized reporting system for all hydrogen incidents;
- an auto fire investigation protocol capable of helping to collect more detailed data on fires involving hydrogen powered vehicles;
- methods of measuring progress in reducing the environmental impacts of producing, transporting and using hydrogen;
- standardized code interpretations of the Model Building and Fire Codes to assist in the permitting of hydrogen infrastructure to provide consistent guidance to fire and building code officials when applying the codes that are in effect in their respective jurisdictions;
- recommended practices to provide guidance to state and local code officials while the Model Codes were being amended;
- a national database on what codes are enforced by whom, jurisdiction by jurisdiction.

HELP also achieved accreditation as an American National Standards developer by the American National Standards Institute (ANSI) in order to develop recommended standards and other forms of guidance including best practices and protocols in support of HELP's mission statement. In addition to stringent requirements for balance and fairness required in ANSI-approved operating procedures, HELP placed emphasis on the development of science-based recommendations. The ANSI accreditation was intended as a mechanism to provide additional credibility for HELP products, and as a service to HELP members.

NASFM created a website for HELP at <http://www.nasfmhydrogen.com/> that contains meeting information, presentations, summaries of training programs, HELP-sponsored guidance documents and links to resources on hydrogen emergency response. The website continues to be maintained.

Having defined and established budgets to implement many of the projects listed above, HELP was ultimately unable to attract the funding to fully realize most of them. DOT RITA funding was not renewed after 2007, and industry was ultimately unable to contribute more than in-kind resources such as experts and information/training materials that had already been developed outside of HELP.

Accomplishments of HELP and of NASFM to Date

Nevertheless, in the short span of its most vigorous activity, HELP produced two very useful resources (both of which are posted on the HELP website at

http://www.nasfmhydrogen.com/codes_overview.php). These resources are in need of wider distribution in those jurisdictions in which the International Code Council family of codes is in effect:

- “Site Evaluation Worksheet for Flammable Gas Storage: Stationary Hydrogen Fuel Cells” – This document, developed by Paul J. Buehler of Buehler Outside Plant Engineering Co., provides typical hydrogen storage citing criteria for quantities less than 4,226 standard cubic feet and 4,226 to 21,125 scf. It references the 2006 editions of the International Building Code, International Mechanical Code and International Fuel Gas Code (which have references to the International Fire Code). This document was used in the NASFM-DOE hydrogen permitting workshops mentioned below as well as in subsequent training to individual fire departments. This document has been adopted by several fuel cell companies and was disseminated by Chief John Mueller in New York State while he was acting State Fire Administrator.
- “2006 I-Codes Application Matrix: Stationary Hydrogen Fuel Cell Installation with Outdoor Hydrogen Storage” – This document, authored by Robert J. Davidson of Davidson Code Concepts, LLC, provides a pathway to references to the International Building Code, International Fire Code, International Mechanical Code and International Fuel Gas Code to enable code enforcement officials to conduct plan reviews for the full range of outdoor hydrogen storage applications. It has been used in the NASFM-DOE hydrogen permitting workshops mentioned below, as well as for work by NASFM consultants with individual departments engaged in permitting activities.

DOE-Sponsored Hydrogen Workshops

In 2008, after RITA declined to fund HELP, the Department of Energy (DOE), through the National Renewable Energy Laboratory (NREL) approached NASFM/HELP to develop and present a series of very successful Hydrogen Workshops for code enforcement officials entitled “Permitting Hydrogen Fueling Stations and Hydrogen Fuel Cell Backup Power for Wireless Telecommunication Sites.” Hydrogen permitting workshops coordinated by NASFM/HELP and instructed/facilitated by Davidson Code Concepts, LLC, were held in New Jersey, California (2) and Michigan, for audiences of respected building, fire and electrical code officials as well as emergency responders, policy-level code officials, industry representatives, automakers, and those who work with the codes on a daily basis.

The format of the New Jersey and California workshops was to present “case studies” to an invited group of fire and building code officials with the objective of demonstrating how existing codes and standards, or engineering solutions based on the latest codes (“alternative methods”), have been or can be applied to permit construction of a hydrogen motor-fueling station or hydrogen-fuel cell powered wireless telecommunications site in a rigorous but timely manner. Additional goals were to have students review and vet the permitting process to suggest ways to make it more efficient and cost-effective for all involved, and to uncover codes and standards gaps or conflicts (if any) that needed to be

addressed in their respective states, as exemplified by the case studies. The workshops were structured to allow time for each group to discuss the results of their case studies in a format where lessons learned could be shared with the full group. The guidance documents produced by HELP on codes application and site evaluation were distributed and used in the workshops. Emergency responder safety was also covered in the workshops. Because of differences in applicable codes from state to state and jurisdiction to jurisdiction, minor adjustments were made to the agenda to address local modifications, issues and needs.

Reports of these workshops are located on the HELP website as well as on the DOE website at http://www.hydrogen.energy.gov/permitting/stations_related.cfm.

These workshops were especially valuable because, without code official education, a “bottleneck” is likely to occur as new technology enters the market due to delays in permitting resulting from insufficient understanding of the technology. NASFM’s hydrogen workshops were aimed at alleviating this potential conflict.

NASFM/HELP is no longer conducting these workshops in partnership with DOE/NREL, but the expert facilitators are scheduled to conduct an “alternative fuels” workshop covering hydrogen and ethanol this July in Georgia as part of that state’s annual fire prevention training symposium. The materials developed by HELP will be used in this workshop. The educational need still exists, now more than ever, as more hydrogen infrastructure is proposed. The word-of-mouth success of the workshops that were conducted created a demand for additional workshops across the country that is currently exceeding what can be delivered.

Since the last full HELP meeting in November 2007, the membership of the group has dwindled due to retirements, layoffs, and resignations. Industry in general is financially stressed in many ways, and those who have had a key role in hydrogen-related activities are in some cases no longer involved. If HELP were to regain funding and resume activity, we would recommend that it be restructured and streamlined while remaining inclusive of all stakeholders. This topic will be addressed more completely in the recommendations section of the 12-month report to this contract.

Current Activities to Educate Fire and Building Code Officials About Hydrogen

NASFM’s technical experts on hydrogen issues have continued to remain involved in the field and hydrogen-related education of code officials and emergency responders:

NASFM member Chief John Mueller, Deputy State Fire Administrator of New York State’s Office of Fire Prevention and Control, is a voting member (Code Enforcement interest category) of the International Code Council’s Hydrogen Industry Panel on Codes (HIPOC), a DOE-funded initiative, which is working to enhance and clarify codes and standards governing hydrogen. Chief Mueller has been a champion in the development of fire safety codes at every level – state, national and international. His service includes work on the technical subcommittee for the Fire Code of New York State, the New York

State Fire Prevention and Building Code Council as the official designee of the State Fire Administrator and membership on the International Fire Code Development Committee, where he serves as vice-chairman. He is also active in the development of international reference standards through involvement with the ASTM International Fire Standards Committee and National Fire Protection Association Committees. In 2008, Chief Mueller was presented with the International Code Council Fire Safety Leadership Award.

Consultant Robert J. Davidson was recently appointed as an alternate member to the Code Enforcement interest category of HIPOC for a 36-month term. He also continues to give presentations to fire officials that address alternative energy supplies that are impacting code officials and the fire service, including hydrogen.

Both Chief Mueller and Mr. Davidson are active in the NASFM Model Codes Committee, which is made up of state and local code officials from across the nation. Through this mechanism, they are sharing information as the codes and standards evolve and also identifying areas where changes might be needed to enhance safety. NASFM's activities involving hydrogen-related codes are addressed later in this report.

Consultant Paul Buehler sat on the NFPA Technical Committee on Hydrogen Technologies, which is working to develop NFPA 2 (Hydrogen Technologies Code). Mr. Buehler also has continued to work on behalf of NASFM with code enforcement officials on hydrogen siting and permitting issues, as well as hydrogen-related code development. Based on this experience, he has prepared a proposal to develop a guidance booklet for code enforcement officials on siting hydrogen fueling systems, which will include applicable codes by state, signage requirements and a checklist of code provisions to facilitate site review. If the funds can be obtained to properly complete and disseminate this booklet, it will be a welcome and well-used resource by code officials and industry alike.

NASFM Senior Project Manager James Narva currently is serving on an Advisory Panel for a Fire Protection Research Foundation project called "Reaching the U.S. Fire Service with Hydrogen Safety Information: A Roadmap the U.S. Department of Energy, which will result in a detailed primer on the structure of the fire service in the United States, both from the fire prevention and emergency response perspectives. The primer will describe jurisdictional boundaries, variation by type of facility, typical responsibilities, and key organizations. For several exemplar jurisdictions, specific information will be identified and compiled on the permitting process for applicable facilities, with a focus on refueling stations and cell phone tower power facilities that are near the permitting stage. This project is scheduled to be completed in December 2009.

Mr. Narva also represents NASFM as a current member of the U.S. Department of Energy (DOE) Hydrogen and Fuel Cell Technical Advisory Committee (HTAC), representing the emergency responder perspective. Mr. Narva joins representatives of domestic industry, academia, other professional societies, government agencies, financial organizations, and environmental groups, as well as experts in hydrogen safety, in fulfilling HTAC's mission of providing technical and programmatic advice to the Energy

Secretary on DOE's hydrogen research, development, and demonstration efforts. As a member of the HTAC during the first quarter of 2009, NASFM participated in preparation of several documents aimed at safely advancing hydrogen. Recent reports of the HTAC can be found at: http://www.hydrogen.energy.gov/advisory_htac.html.

The information, templates, and permitting tools that were developed by HELP (and mentioned in the previous section) are still applicable to code and permitting officials across the country, but at this point absent the resources to promote and deliver the information properly, we are dependent on code officials' seeking and finding the information on their own.

Code Enforcement Officials' Awareness of and Educational Needs on Hydrogen

NASFM has prepared a questionnaire to gauge emergency responders' and code enforcement officials' comfort and awareness of issues related to hydrogen and the permitting of hydrogen infrastructure, as well as their perceived need and desire for education and training. The questionnaire is included as an Appendix to this report. NASFM will distribute the questionnaire throughout the rest of the year to state and local emergency responders and code enforcement officials, and provide the findings and recommendations in our year-end report. We would appreciate the feedback and recommendations of our Volpe Center contacts before the questionnaire is finalized.

Additionally, we have spoken with industry representatives who have worked closely with fire and building code officials in pursuit of permits for hydrogen infrastructure projects in order to get their perspective on code officials' collective state of knowledge, level of preparedness, and need for training based on the applicable codes within the authorities having jurisdiction.

NASFM's preliminary finding is that, except for those officials who have undergone specific training (such as attending a HELP permitting workshop) or have already gone through the exercise of permitting a hydrogen facility, the level of knowledge or competency on hydrogen issues among fire and building code officials is virtually nonexistent, universally. Hydrogen is a completely unknown quantity for code officials, who must (or should, but do not always) do considerable research before issuing a permit. An exception would be in the State of New Jersey where the state agency responsible for building code enforcement contracted with NASFM's consultant, Robert J. Davidson of Davidson Code Concepts, LLC, to present code official CEU courses on "Hydrogen as a Motor Fuel/Hydrogen Fuel Cells: The Future" as part of the mandated CEU update program for licensed code officials in that state.

Unless provided with specific training opportunities, code officials generally confine their self-directed hydrogen education to the applicable codes in a given jurisdiction, whether it is the International Code Council (ICC) family of codes or the National Fire Protection Association (NFPA) family of codes. We have found that the most important initial question to answer when educating code officials about hydrogen is, "Which code applies in your jurisdiction?" The information available on-line and elsewhere about

“what the codes say” regarding hydrogen is of little use if that particular code is not in effect in a given jurisdiction, and confusing applicable rules with non-applicable rules costs time and money.

Within the ICC family of codes, building officials generally will be familiar with the International Building Code and perhaps the International Mechanical Code. Fire officials will be familiar with the International Fire Code and perhaps the International Fuel Gas Code. However, none of the code officials is familiar with anything to do with hydrogen, and they generally must be directed to what to look at in the codebooks. The International Fire Code, in particular, can be confusing in that it has four chapters that contain hydrogen/flammable gas information – 22 (Motor Fuel-Dispensing Facilities And Repair Garages), 27 (Hazardous Materials-General Provisions), 30 (Compressed Gases) and 35 (Flammable Gases).

Within the NFPA family of codes, NFPA 1 (Fire Code) and 101 (Life Safety Code) are usually enacted together, and comprise a chapter on hydrogen, which is extracted from NFPA 55 (Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks). As with the ICC codes, code officials generally are not familiar with this chapter unless they have some previous experience permitting hydrogen. A new code dealing specifically with hydrogen, NFPA 2 (Hydrogen Technologies Code) is currently in development and scheduled to be completed in Fall 2010. Its debut will further necessitate education and training in correct application of the code.

Code Official Database on Hydrogen, by State and Jurisdiction

Because of the practice of jurisdictions’ amending the codes that they adopt, understanding what is in effect in a given jurisdiction has long been a recognized need. Though NASFM’s initial attempts to develop this database did not materialize, NASFM has renewed efforts to address this need. By the final report for this project, we plan to have the framework and initial input for a database that will include the version of the model code in force in a given jurisdiction as well as contact information for the AHJ (fire and building code enforcement offices).

Hydrogen Training Resources for Code Officials and Emergency Responders

As part of its own hydrogen transition program, NASFM has continued to seek out educational resources for fire and building code officials and emergency responders regarding hydrogen safety incident response, permitting and related issues beyond the codes themselves. We have found that relatively few good and reliable resources exist, and there are even fewer that fire and code officials know about and use. Some of them are available at no cost, and some are available for purchase, but fire and code officials often do not have the budgets for such purchases. Our research so far has uncovered the following sources, which we are still in the process of evaluating. We will seek permission to list the best of them on the HELP website and expect to report on the completion of this exercise in our 12-month report.

- The **Department of Energy** site at www.hydrogen.energy.gov contains much good and useful information, including a section that allows one to look up technical papers on hydrogen and related topics. DOE also has developed an 8-hour hydrogen safety training class for first responders that is being offered during 2009 at DOE's Volpentest HAMMER facilities in Richland, WA. DOE offers financial assistance to a limited number of first responders to participate in these courses.
- NASFM worked to reach an agreement with the **California Fuel Cell Partnership** (<http://www.fuelcellpartnership.org/>) to adapt its training materials on hydrogen for emergency responders to be applicable for use nationally once funding becomes available to implement this project.
- The **National Hydrogen Association** websites (<http://www.hydrogenassociation.org/index.asp> and <http://www.hydrogenandfuelcellsafety.org/>) include information on safety, codes and standards, and links for more information.
- **Compressed Gas Association** documents on hydrogen, compressed gases and valves/cylinder fittings are available on www.cganet.org at considerable cost.
- Safetygrams on hydrogen topics are available at no cost from the website of **Air Products**, supplier of hydrogen and hydrogen fuel infrastructure, at <http://www.airproducts.com/Responsibility/EHS/ProductSafety/ProductSafetyInformation/safetygrams.htm>.
- Free Material Safety Data Sheets are available from the websites of **all hydrogen sellers and producers**. These are also available in various foreign languages. These provide some amount of first responder information.
- The **National Aeronautics and Space Administration** (NASA) published a document on hydrogen that is used both for practical applications and also for scientific data (www.hq.nasa.gov/office/codeq/doctree/canceled/871916.pdf). Its "canceled" status acknowledges the need for updating, but it still contains excellent technical data.
- **FM Global** has a document for sale on its website on hydrogen siting, but it is out of date.
- The **Occupational Safety and Health Administration** (OSHA) has hydrogen siting rules that are accessible for free on its website at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9749, but they are similarly out of date.
- Producers of fuel cell technology **Plug Power** (<http://www.plugpower.com/>) and **ReliOn** (<http://www.relion-inc.com/>) have some information on their websites and also in their customer manuals.
- **Universities** have their own rules derived from the codes for using hydrogen and compressed gases in laboratories, which can be useful when applied to the indoor environment.
- There are several websites available, some for pay, that assist with hydrogen infrastructure **siting and design**, which are not widely known, nor widely used.
- There is some information in the **National Electrical Code** and from a few other sources, like ISO and some US Army technical manuals.

- **General Motors** offers an Emergency Responder Training Program through its Fuel Cell Research Laboratory near Rochester, NY. NASFM is in the process of making contact to see if we can partner with GM to deliver the training program in anticipation of more hydrogen fuel cell cars on the road in the coming years.

Codes and Standards Development and Clarification Needs

The impact on the extended hydrogen infrastructure, e.g., fueling stations in various settings, underground parking garages, etc., has been the subject of discussion in the national Model Codes, but has not yet been studied in ways that yield credible data to guide public safety authorities.

NASFM's Role in the 2008 Code Hearings

The NASFM Model Code Committee and its consultant, Robert J. Davidson of Davidson Code Concepts, LLC, participated in changes affecting the use of hydrogen as a fuel by submitting code change proposals or testifying on those submitted by others during the International Code Council Code Development Hearings, leading to changes in the 2009 editions of the I-Codes.

A proposal by fire service representatives to control the location of structures or storage within high-voltage transmission line right of ways resulted in the prohibition of any hazardous material storage regardless of its intended use. This would have had an impact on the growing application of stationary hydrogen-fuel cells as backup power sources for telecommunications installations. NASFM was successful in having the adopted code language modified to provide for an exception for fuels used for backup power equipment. (See Section 316.5 of the 2009 edition of the International Fire Code.)

With NASFM Model Code Committee support, NASFM successfully proposed corrections to the general requirement section of the IFC chapter dealing with flammable gases and specifically the use of hydrogen as a fuel. The scoping section had incorrect language that was causing problems for code officials reviewing construction code applications for the use of hydrogen as a fuel. (See Section 3501.1 of the 2009 edition of the International Fire Code.)

With NASFM Model Code Committee support, NASFM assisted with the development, submission and successful testimony for code language to guide code officials when dealing with metal hydrides used for the storage of gaseous hydrogen. (See Section 3507 of the 2009 edition of the International Fire Code.)

With NASFM Model Code Committee support, NASFM successfully modified Section 633 of the International Fuel Gas Code and Section 924 of the International Mechanical Code to provide clarification that both the International Building Code and the International Fire Code must be consulted when installing a stationary hydrogen-fuel power system. This provided needed guidance to designers and code officials.

With NASFM Model Code Committee support, NASFM successfully modified Section 307.1 of the International Building Code to clarify that hazardous materials located on a roof or a canopy are to be treated as “outdoor storage or use” in accordance with the International Fire Code. This eliminated a problem where code officials were improperly classifying such installations as a high-hazard occupancy and placing hurdles in the way of hydrogen fuel installations.

Hydrogen Industry Panel on Codes (HIPOC) Proposal

NASFM’s representatives on HIPOC, Chief John Mueller and alternate Robert J. Davidson, participated in discussions during the National Hydrogen Association Annual Conference March 29-April 2, concerning industry actions to have the International Fire Code (IFC) simply refer to NFPA 55 for matters concerning hydrogen installations (when it is published in 2010, NFPA 2 will take over the information in NFPA 55). This action, if taken, would eliminate IFC committee influence on code requirements, in deference to the industry-dominated NFPA standards committees. HIPOC has preliminarily agreed that it would be preferable for the IFC committee and ultimately the ICC membership to retain control of the topic. HIPOC has preliminarily agreed to draft a submittal concerning the issue of defaulting to NFPA 55 and to follow the HIPOC process concerning separation distances. Additionally, NASFM is preparing a draft proposal of its own for consideration by the NASFM Model Codes Committee to ensure the issue comes before the ICC Fire Code Committee.

Need for Harmonization of Codes

An issue that NASFM believes will need to be addressed in the future is the harmonization of codes related to hydrogen. The hydrogen-related requirements in the International Fire Code (IFC) and in NFPA 55 (Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks) will need to be reconciled with NFPA 2 (Hydrogen Technologies Code), which is still in development and due to be issued in 2010. As it is shaping up, NFPA 2 will differ significantly in content and intent from NFPA 55 and the IFC. For example:

- NFPA 2 will have a four-tiered table for setback distances related to pressure. However, NFPA 55, the IFC and all other codes or standards for any element use only mass as the determining criterion for setback distances. The changes proposed in NFPA 2 will be drastically different from setbacks currently used in any existing code.
- NFPA 2’s setback distances table will have mitigating factors, which will allow distances to be reduced in certain circumstances.
- Currently the IFC has different setback requirements for hydrogen stored for use in automotive operations vs. hydrogen stored for other purposes. These distances are different from distances currently specified by NFPA 52 (Vehicular Fuel

Systems Code) and NFPA 55. NFPA 52 is going to be included in NFPA 2, so the discrepancies likely will continue as NFPA 2 is promulgated.

The need to harmonize the various hydrogen-related codes and standards is clear, so that setback distances across the United States are equalized and code enforcers have one set of rules to follow. Without this synchronization, drastically different codes will be in force across the nation for the same quantity/mass of hydrogen.

Lessons Learned

The role of code officials and emergency responders is extremely important and cannot be overlooked as this nation transitions away from fossil fuels to more sustainable technologies and fuels. Uneducated, undertrained emergency responders, and code and permitting officials can be a bottleneck to the introduction of new technologies. The NASFM/HELP effort has been aimed at addressing and eliminating the bottleneck, as well as emphasizing the safety aspects of hydrogen, as they differ from traditional petrochemical fuels. In the process of doing so, we have learned the following lessons:

- Among these key audiences of emergency responders and code enforcement officials there is very little practical knowledge on hydrogen. The most basic information is required – for example, how to read the codes in the correct sequence. To address needs such as this, the “2006 I-Codes Application Matrix: Stationary Hydrogen Fuel Cell Installation with Outdoor Hydrogen Storage” developed by Robert J. Davidson and the “Site Evaluation Worksheet for Flammable Gas Storage: Stationary Hydrogen Fuel Cells” developed by Paul Buehler for HELP have been exactly the right type of resources to allow code officials in ICC jurisdictions to logically and methodically work through the applicable codes. There is a need for more practical resources that very clearly show the code officials how to apply the codes so that they are not faced with having to do a great deal of research on their own.
- HELP showed the value in bringing all the stakeholders to the table with the common goal of reaching this audience, to develop a plan and solutions cooperatively rather than talking to each group separately and trying to develop a consensus among competing agendas.
- Though our original guidance from DOE/NREL on the hydrogen permitting workshops was to invite only building and fire code officials, NASFM recognizes that code enforcement is conducted by a wide range of state and local agencies, which themselves vary in terms of sophistication, knowledge of the codes and adequacy of resources. As such, it is important to invite a diverse group of attendees/code officials to bring different perspectives as well as experiences. For example, given the interaction among all the various disciplines in an actual permitting process, it was apparent that we needed to include individuals well versed in the electrical codes, since they, too, are involved in siting hydrogen applications. After making the case for this fact with DOE/NREL, we were able to open our workshops up to include a range of code officials from different relevant disciplines.

- Most states and many local governments routinely amend the Model Codes. For example, most major jurisdictions will accept the hazardous material storage requirements recommended by the International Codes Council and National Fire Protection Association, but some may prohibit the storage of hydrogen. Therefore, we have learned the importance of recognizing regional differences in which code requirements are adopted and enforced and by whom. Each state may present a new and different challenge to those interested in educating code officials about the permitting of hydrogen refueling stations. Because of these differences, the regional workshop approach is appropriate for an effective strategy. State fire and building code officials know, understand and routinely address these differences as they exist within their own states.
- We have learned the importance of using well-known and well-respected experts that have a background that includes work as a local code official and/or fire service membership as instructors. Code officials will make a special effort to attend a training session featuring code experts that they can relate to. NASFM's Model Codes Committee as well as our code enforcement technical experts have such reputations.
- We have learned to leverage existing training sessions and other meetings attended by code officials. All government officials must justify time taken from their primary responsibilities. Combining hydrogen workshops with existing meetings results in greater efficiency and is much appreciated by code agencies, which must cover travel and compensation costs. State fire and building code officials often sponsor or work closely with others who organize regional meetings of code officials, so we seek these efficiencies for every meeting we schedule.
- We have learned to actively promote each workshop through the established communications channels that exist between states and their counties and municipalities to recruit participants. Each state has its own means of ensuring on-going communication among those engaged in code enforcement. States may rely on restricted-access websites, newsletters, conference calls, regional meetings and individual briefings. State fire and building code authorities typically take the lead in maintaining these communications channels.
- Based on the drastic differences in setback distances for stored hydrogen, depending on which set of model codes is used, codes and standards regarding hydrogen need to be better harmonized so that code enforcers have a consistent set of agreed-upon and scientifically derived rules to apply across the nation.
- In reviewing how HELP could have been more useful in its mission, NASFM would in the future focus more on defining projects into useful topics for both emergency response and permitting applications, such as liquid hydrogen storage, small installations of gaseous hydrogen, large installations of gaseous hydrogen, motor vehicle fueling stations, and motor vehicles in general.

In Conclusion

The public interest will be served by a significant transition from fossil fuels to hydrogen fuels, and the transition appears inevitable. Over time, improvements in human health and environmental quality will result from reduced air emissions if hydrogen is a fuel source. In addition, hydrogen fuel cell technologies should strengthen United States' energy independence. But experts do not agree on which hydrogen fuel cell technologies will emerge and when.

The hydrogen industry is competing within itself, as well as with other alternative fuels and their technologies, for supremacy. The lack of a consensus on a single technology, much less timing, is evidence of healthy competition that can only serve the public interest in cleaner, safer and more affordable automobiles, backup power supplies and other applications. This lack of consensus means that the development of comprehensive new safety standards may be premature. But meaningful risk assessments of some elements of the anticipated risk scenarios posed by the various technologies are possible now.

For the transition to move forward smoothly, this process must be science-based, inclusive, and fully transparent. Where informed and rational guidance is not forthcoming, emotion and narrow commercial interests too often prevail. Widespread use of hydrogen will be no different. Where emergency responders and code enforcers are sufficiently educated on the issues and comfortable with safety precautions, they will be facilitators of, rather than impediments to progress, and when that occurs, community support is more likely to follow.

Perhaps most important, nothing that results from this transition justifies any relaxation in current levels of safety. The public interest in safety, improved air quality and energy independence will be served only if industry, consumers, government authorities and public safety authorities achieve common understanding and agree to work cooperatively toward solutions as the transition to hydrogen fuel cell technologies proceeds.

Appendix:

QUESTIONNAIRE: CODE OFFICIALS and HYDROGEN ISSUES
--

The National Association of State Fire Marshals (NASFM) is partnering with the Volpe National Transportation Systems Center of US Department of Transportation (US DOT) to provide expertise in preparing code officials and emergency responders for the safe and orderly transition to hydrogen as an alternative fuel in communities, and to help provide the link between hydrogen resources and the audiences who need them.

As part of this agreement, NASFM is distributing this questionnaire to assess the level of awareness and readiness of code officials to deal with hydrogen-related issues.

1. Are you aware of the benefits of transitioning to hydrogen as an alternative fuel?

<i>Yes</i>	<i>No</i>

2. If yes, please state which benefit you believe is most important.

3. Please rank the following barriers from 1 (most important) to 6 (least important) in terms of obstacles faced by communities in transitioning to hydrogen as an alternative fuel?

- Availability of alternative fuel refueling infrastructure
- High costs to construct refueling infrastructure
- High costs to purchase alternative fuel vehicles (AFV)
- Inconsistency in public policy and leadership messages
- Lack of customer awareness and market acceptance
- Inconsistent codes and standards

4. Please rate your comfort level on a scale of 1 – 10, with 10 being extremely comfortable and 1 being not at all comfortable, with hydrogen being used in vehicles and located at your neighborhood fueling station as well as being used in applications for emergency back-up power?

Not at all *Extremely*
Comfortable *Comfortable*
1 2 3 4 5 6 7 8 9 10

5. Does your office have jurisdiction to permit and regulate hydrogen-related construction?

<i>Yes</i>	<i>No</i>

6. If yes, are you currently doing so?

<i>Yes</i>	<i>No</i>

7. Do you know what codes apply to the permitting of hydrogen related infrastructure in your jurisdiction?

<i>Yes</i>	<i>No</i>

8. Would you take advantage of education and training to prepare yourself and/or your staff to better understand and deal with hydrogen vehicles, fueling stations and other applications?

- Yes, absolutely
- Yes, but only if it's free
- Probably not, because it's not an issue in our jurisdiction
- No

9. What could be done to facilitate the permitting process for hydrogen-related infrastructure in your jurisdiction?

10. How do we ensure safety concerns are met while not impeding hydrogen usage in your state?

11. There have been recent code changes dealing with hydrogen. Has your jurisdiction adopted new codes and standards related to hydrogen?

<i>Yes</i>	<i>No</i>

12. If yes, what model codes have you adopted?

13. If no, what version of the model codes are you enforcing?

14. Which of the following strategies would be most helpful in educating and training the fire service in your state to better understand and deal with hydrogen vehicles, fueling stations and other applications. Please check all that apply.

- Tax Incentives Grants & Other Financial Incentives
- Regulatory Incentives Outreach & Education Demonstration projects
- State and federal leadership and program messages

15. What other alternative fuels are you interested in learning more about from a code enforcement, permitting or emergency response standpoint (check all that apply)?

- Biodiesel
- Ethanol
- Electricity
- Natural Gas
- Propane
- Other: _____

16. Comments?

17. Would you be willing to discuss your answers to these questions in greater detail by phone?

<i>Yes</i>	<i>No</i>

If you answered “Yes” to question 17, please provide your contact information:

Name: _____

Job Title: _____

Company Name: _____

Work Phone: _____

E-mail Address: _____

Thank you for your participation!
Please return this form to:
National Association of State Fire Marshals
1319 F Street, NW, Suite 301
Washington, DC 20004
Fax: 202-393-1296
E-mail: cmorgan-price@firemarshals.org