THE HYDROGEN EXECUTIVE LEADERSHIP PANEL (HELP) INITIATIVE FOR EMERGENCY RESPONDER TRAINING

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Abstract

In close cooperation with their Canadian counterparts, United States public safety authorities are taking the first steps towards creating a proper infrastructure to ensure the safe use of the new hydrogen fuel cells now being introduced commercially. Currently, public safety officials are being asked to permit hydrogen fuel cells for stationary power, and as emergency power backups for the telecommunications towers that exist everywhere. Consistent application of the safety codes is difficult – in part because it is new – yet it is far more complex to train emergency responders to deal safely with the inevitable hydrogen incidents. The US and Canadian building and fire codes and standards are similar but not identical. The US and Canadian rules are unlikely to be useful to other nations without modification to suit different regulatory systems.

However, emergency responder safety training is potentially more universal. The risks, strategies and tactics are unlikely to differ much by region. The Hydrogen Executive Leadership Panel (HELP) made emergency responder safety training its first priority because the transition to hydrogen depends on keeping incidents small and inoffensive, and the public and responders safe from harm. One might think that advising 1.2 million firefighters and 800,000 law enforcement officers about hydrogen risks is no more complicated than adding guidance to a website. One would be wrong. The term "training" has specific, legal implications, which may vary, by state. For hazardous materials, federal requirements apply. Insurance companies place training requirements on the policies they sell to fire departments, including the thousands of small, all-volunteer departments which may operate as private corporations. Union contracts may define training, and promotions may be based on satisfactorily completed certain levels of training. Emergency responders could no sooner learn how to extinguish a hydrogen fire by reading a webpage, than a person could learn to ride a bicycle by reading a book. Procedures must be learned by listening, reading and then doing. Regular practice is necessary. As new hydrogen applications are commercialized, additional responder training may be necessary. This highlights another obstacle, emergency responders' ability to travel distances and take the time to undergo training. Historically, fire academies established adjunct instructor programs and satellite academies to bring the training to firefighters. The large, well-equipped academies are typically used for specialized training. States rarely have enough instructors, and instructors often must take the time to create a course outline, research each point and produce a program that is informative, useful and holds the attention of responders. The challenge of training emergency responders seems next to impossible, but public safety authorities are asked to tackle the impossible every day, and a model exists to move forward in the U.S. Over the past few years, the National Association of State Fire Marshals and U.S. Department of Transportation enlisted the help of emergency responders and industry to create a standardized approach to train emergency responders to deal with pipeline

incidents. A curriculum and training materials were created and more than 26,000 sets have been distributed for free to public safety agencies nationwide. More than 8,000 instructors have been trained to use these materials that are now part of the regular training in 23 states. Using this model, HELP intends to ensure that all emergency responders are trained to address hydrogen risks. The model and the rigorous scenario analysis and review used to developing the operational and technical training is addressed in this paper.

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Introduction

United States public safety authorities are taking the first steps towards creating a proper infrastructure to ensure the safe use of the new hydrogen fuel cells now being introduced commercially. It is instructive to note that in the U.S. local officials have struggled with the permitting of dispensing units for the alternative motor fuel known as E-85, i.e., 85% ethanol. The lack of an appropriate safety standard for these dispensing units has stood in the way of virtually billions of dollars now being invested in the production, transportation, storage, sale and use of ethanol fuels. In consultation with safety authorities in Brazil, Sweden, Canada and other nations where ethanol has been used for decades, a properly certified standard will be developed but this one example illustrates the importance of industries and governments paying strict attention to the smallest details and following an ordered process.

The good news is that the Hydrogen Executive Leadership Panel (HELP) has assembled a diverse teams of experts to help cooperatively build a hydrogen public safety infrastructure capable of keeping people safe and building public confidence. Co-sponsored by the United States Department of Transportation (USDOT), National Association of State Fire Marshals (NASFM) and Council of Canadian Fire Marshals and Fire Commissioners; HELP has brought together senior executives and experts from federal and state government, emergency response agencies; the energy, auto, insurance and technology industry sectors; scientific and technical communities; and consumer interests.

HELP's mission is to ensure the safest possible transition from fossil fuels to alternative energy sources. That path is currently moving through biofuels but there is little doubt that it is headed towards hydrogen.

General Motors has already begun a comprehensive deployment plan named "Project Driveway" and is planning to begin leasing more than 100 Chevrolet Equinox Fuel Cell vehicles in the fall of 2007. A variety of drivers, in differing driving environments, will begin operating these vehicles and refuel with hydrogen in three geographic areas: California, the New York metropolitan area and Washington D.C. [1]

BMW Group has also announced the introduction of the new BMW Hydrogen 7, the world's first hydrogen-drive luxury performance automobile for everyday use. It is equipped with an internal combustion engine capable of running either on hydrogen or on gasoline and based on the BMW 7 Series. BMW has also announced that they will begin leasing approximately 100 vehicles that will be able to switch between burning standard gasoline and hydrogen so that drivers will not be left stranded while the infrastructure to deliver hydrogen is built up. [2]

It is upon us now to aggressively prepare our emergency responders to safely deal with these vehicles and the infrastructure to support them for the inevitable day when something goes wrong, the success our emergency responders have will be directly attributable to how well we prepare them to succeed.

Building a public safety infrastructure for hydrogen as an energy source

Local permitting may be problematic because the hydrogen-related language in the prevailing model national building and fire codes was not written with these applications in mind. Not surprisingly, some projects have been rejected and, at best, permitting has been inconsistent among jurisdictions.

But through the forum created by HELP, Shell Hydrogen and Chevron are working with the U.S. Department of Energy and building and fire code enforcement officials to make sense of the rules governing the addition of hydrogen to existing refueling stations, and much the same exercise is underway directly with code officials, at the request of HELP member Plug Power, to benefit the use of hydrogen fuel cells as backup emergency power for telecommunications cell phone towers. Unlike the Shell Hydrogen-Chevron project, which is focusing on demonstration projects, the Plug Power technologies are commercially available and are likely to be among the first hydrogen fuel cells in use in many communities.

But the permitting of hydrogen projects is not an isolated function. In the U.S., very few of the 1.2 million firefighters and 800,000 law enforcement officers have been trained to respond safely to incidents involving hybrid gas-electric autos and shipments of ethanol, much less hydrogen. In consultations with public safety officials worldwide, we see little evidence that any nation is adequately prepared for the transition. All humans care about safety. In the American Midwest, Bavaria, Hong Kong or anywhere else, for communities to welcome these new technologies they must have confidence in the safety of alternative energy sources, and that confidence begins by knowing that local responders are prepared and equipped to protect them when incidents occur.

According to U.S. DOT's Hazardous Materials Information System, 10,238 of the reported 20,328 hazardous materials incidents reported in the U.S. in 2006, involved "flammable-combustible liquid," [3] the most common of which are gasoline and diesel that comprise the bulk of the 800,000 motor carrier hazardous materials shipments on U.S. roads every day. [4] We can manage some of the risks of handling large volumes of hydrogen, but motor carrier shipments of hydrogen will be subject to the same human errors, road and weather conditions that contribute to the large number of transportation incidents involving fossil fuels. Emergency responders have years of experience with gasoline and diesel incidents, and as a result, in all of those reported 10,238 incidents reported in 2006, just six persons died and nine were hospitalized.

As hydrogen replaces fossil fuels in hazardous materials transportation with motor carriers, rail and eventually pipeline, industry must continue to engineer systems to prevent incidents. But it will take well-trained and equipped emergency responders to minimize the losses from those incidents that occur.

Preparing emergency responders for hydrogen

Fortunately, NASFM and U.S. DOT have created the means to reach emergency responders with training materials and guidance through a six-year Partnership for Excellence for Excellence in Pipeline Safety. This model will be applied to Canada and be available to public safety authorities worldwide. The Partnership has already developed the *Pipeline Emergencies* training program which is a comprehensive, integrated emergency response training program designed to instruct emergency responders and pipeline industry personnel to safely respond and effectively manage pipeline incidents. The *Pipeline Emergencies* training program is supported by a 179-page full color textbook NASFM and DOT in cooperation with the pipeline industry and emergency response agencies. The textbook is supported by a Curriculum Instructor's Guide and companion Power Point presentations. The Power Point program includes 10 interactive pipeline emergency scenarios that permit the instructor to explore fire and non-fire situations involving liquid and gas pipelines with the students. The program also includes CD-Rom, training videotape and a dedicated website where instructors can acquire information on training materials, instructor tips, and links to other websites. All of the training materials described above are distributed at no cost to fire training agencies through NASFM. More than 26,000 pipeline safety training packets have been distributed for free to public safety agencies nationwide, and more than 8,000 instructors have been trained to use these materials as part of the regular training in 23 states. Using this model, HELP intends to ensure that all emergency responders are trained to address hydrogen risks at the operational level.

In November 2006, HELP's Safe Energy Emergency Response Advisory (SEERA) committee and a working group of additional experts met for two days to design a curriculum and dissemination strategy intended to prepare U.S. firefighters, law enforcement officials and emergency medical specialists to respond safely and efficiently to hydrogen incidents.

This group issued a series of recommendations and an outline for the development and implementation of a HELP Alternative Fuel Vehicle (HELP AFV) training curriculum. It was suggested that the HELP AFV training program be developed in a modular format in order to adjust to the ever-changing nature of the information and technology in the field. Initial modules will focus on a variety of fuels including hydrogen, hybrid (gas/electric) and ethanol. In order to address the needs of the emergency response services the modules will address training levels commonly used in the Fire, Police and EMS sectors—First Responder Awareness and First Responder Operations level training. Every emergency responder needs to be trained to an awareness level, with those on the front lines every day at an operational level.

The HELP AFV training materials will have several components. The program format of each module will consist of three elements: Fuels / Power Supply, Vehicle Construction / Specific Features and Response Procedures. The response procedures will include information on general safety, stabilization, suppression, rescue and primary extrication hazards. The Core Curriculum for each module would be formatted as indicated for the targeted vehicle including but not limited to the following subject matter:

- Fuel / Power
    1. Fuel type / state
    2. Fuel hazards and properties
    3. Recognition and identification of fuel
- Vehicle Construction / Features
    1. Overview of alternative vehicles
    2. Automotive type / design
    3. Recognition and identification of vehicle
    4. Vehicle hazards and properties
- Response Procedures
    1. Safety and size up issues
    2. Initial actions for securing the hazards
    3. Vehicle / fuel stabilization actions
    4. Incident action plans/procedures for response to vehicle specific and hazard
    5. Response to fuel release
        - Fire
        - Spill
    6. Primary Extrication
- Model sops/guidelines similar to DOT Emergency Response Guide format
- Other response issues (as applicable)
    1. First Aid
    2. Hazardous Materials

The Student training materials would include a student manual and electronic student CD that would include a student workbook, exercises and scenarios, quizzes, reference manuals and illustrations from manufacturers. The scenario based exercises would include a multiple-type vehicle accident with victims, a fueling station accident with / or without fire, an auto fire in a residential or commercial garage, a fixed fuel cell fire or accident (Hydrogen) and others scenarios to be determined.

The Instructor Package would be a CD Rom and include PowerPoint presentations, a facilitator guide, instructor notes and topics for discussion on the scenario-based exercises, Quizzes and Unit Test and additional game-like learning activities.

There will also be a stand-alone HELP-AFV Video that covers each AFV addressed in the program modules.

The program would follow or use the training guidelines provided by organizations that achieve the goals of emergency responders, regulatory agencies and industry. These organizations will include NASFM, International Association of Fire Chiefs (IAFC), National Fire Protection Association (NFPA), U.S. Occupational Safety and Heath Administration (OSHA), American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), American Society of Manufacturing Engineers (ASME), and Society of Automotive Engineers (SAE). Since many of the

fuels are hazardous materials, the training program will address response issues found in the emergency response standards NFPA 472 Professional Competencies for Response to Hazardous Materials [5] and NFPA 1001 Professional Competencies for Fire Fighters [6]. It also recommended that the program address 29 OSHA CFR 1910.120 Hazardous Waste Operations and Emergency Response (HAZWOPER) [7] and 29 OSHA 1910.156 Incipient and Structural Fire Fighting Standard [8].

Reaching Emergency Responders

Reaching, much less training 1.2 million firefighters and 800,000 law enforcement officers is no small feat. The term "training" has specific, legal implications, which may vary, by state. For hazardous materials, federal requirements apply. Insurance companies place training requirements on the policies they sell to fire departments, including the thousands of small, all-volunteer departments which may operate as private corporations. Union contracts may define training, and promotions may be based on satisfactorily completing certain levels of training. Procedures must be learned by listening, reading and then doing. Most importantly to emergency responders, regular practice is necessary. As new hydrogen and other AFV applications are commercialized, additional responder training will be necessary. This highlights another obstacle, emergency responders' ability to travel distances and the time necessary for additional training for volunteer firefighters with limited time to offer. Historically, fire academies established adjunct instructor programs and satellite academies to bring the training to firefighters. As mentioned previously, the large, well-equipped academies are typically used for specialized training. States rarely have enough instructors, and instructors often must take the time to create a course outline, research each point and produce a program that is informative, useful and holds the attention of responders. In order to address these issues, the program will have several mechanisms designed to reach emergency responders in a variety of ways.

Train the Trainer Courses

First, the program will conduct several train-the-trainers (TTT) sessions throughout the U.S. in order to prepare experienced emergency response training instructors to deliver the HELP AFV training program curriculum to other emergency responders. The course would focus on familiarizing instructors with the training materials and the options available for delivering the course to various audiences and skill levels. The relationship in the classroom for the Train-The-Trainer course will be Instructor-To-Instructor rather than Instructor-To-Student.

The TTT session would be delivered using a multi-level approach to introduce the states to the program. The multi-level approach would include a series of scheduled TTTs that would be conducted regionally and would target strategic markets and the major national emergency response conferences to provide the best exposure for the program. Additional TTTs at the local level could also be wholly subsidized by grants, support from the local auto representatives or organizational budgets.

These courses would be sanctioned by NASFM with the goal of helping states achieve national fire service accreditation in order to meet national professional qualification standards. By meeting this level of accreditation more effective and responsive performance measures can be developed.

The training materials would then be recognized as having met the rigors of review by an independent organization. This independent review is the best way to assure all concerned parties that the training program meets national standards and helps train emergency responders to safely protect themselves and the public.

Regional Training Centers

Regional training sites must also be established that are able to support the training program through existing academies that ideally have advanced research capabilities and have the ability to interface the information and training with the academic and vocational elements in the region. SEERA recommended that an interim committee might be considered to address a detailed examination of the exact mission of the regional education centers starting with mission objectives, roles, location and

sitting recommendations In addition, there will be small regional committees of industry, regulatory, academic and response representatives to determine the exact needs of the site with particular emphasis on training ground recommendations, equipment design - exterior and interior props. There also must be a strong relationship and extensive support between the regional site and manufacturers and federal agencies. TTTs would also be delivered in each of the designated regional training sites above to promote the regional school or introduce the area to the new training modules.

Mobile Training Units

In order to address the problems of emergency responders' often not having the ability to travel distances and time necessary for additional training for volunteer firefighters with limited time to offer, HELP recommends that mobile training academies at both the state and local level be a part of the HELP AFV training program. Smaller, extremely mobile training systems consisting of equipment, mock-ups and simulators must be developed and designed to travel around a designated area to train responders. While regional training sites would be comprehensive, the local, county, or metro fire departments may not be able to send responders to the larger sites for training due to a variety of limitations. State instructors who can deliver the training could transport the mobile training units to training sites. These vehicles or trailers would have props, equipment and visuals to conduct in-service training and mobile training academy designs would be made available by HELP to any community that wanted to develop their own units. Strong industry partnerships are needed here in order to provide fire departments with the necessary equipment. Local automobile dealerships for example, could provide real and positive impact to their communities by partnering with local emergency response organizations to help provide these resources.

Flexibility within the model

In the case of the *Pipeline Emergencies* program distribution and implementation of the training curriculum varied slightly from state to state depending on a variety of factors ranging from the size of the state, rural vs. urban influences, the presence of existing university and state training networks, and numbers of career and volunteer departments. HELP intends to use the lessons learned from this program in the distribution of a HELP AFV training program.

Regional approach within larger states

Large states require a regional approach within the state in order to reach as many emergency responders as possible. For example, California is a state where the HELP AFV TTT classes would need to be held in multiple locations to reach responders. In addition, HELP will work with existing curriculum when deemed appropriate.

Utilizing existing university and state training networks

The *Pipeline Emergencies* training program was launched in coordination with the Maryland Fire and Rescue Training Institute, Oklahoma State University's School of Fire Protection and Texas A&M's Texas Engineering Extension Service. NASFM worked closely with these existing university fire training program to run TTT classes using the model to be disseminated by the institutions' own trainers.

The HELP AFV training program will be implemented the same way in states with existing university and state training schools and will be broadened to include more universities as they are identified to be beneficial to the program. To date, HELP has been working with the University of Montana-College of Technology, West Virginia University's National Alternative Fuels Training Consortium and the California Fuel Cell Partnership.

Targeted based on need

The HELP AFV training will also be targeted based on the needs of specific communities and types of fire departments. High consequence urban areas with AFV fueling stations will receive first priority. In the case of volunteer fire departments the training needs of firefighters will be accommodated in any way possible to ensure effective delivery of the training program.

Conclusion

Public safety officials in every nation are and should be a full partner as society makes the critical transition from fossil fuels to alternative energy sources including hydrogen. Establishment of a public safety infrastructure will require careful attention to details ranging from existing rules to new science. Loss prevention is the goal, but this infrastructure must begin with emergency responders prepared and equipped to deal with the inevitable incidents.

Through the Hydrogen Executive Leadership Panel, emergency responders, regulators, industries and others are creating a hydrogen public safety infrastructure in ways that will keep people safe and build public confidence.

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