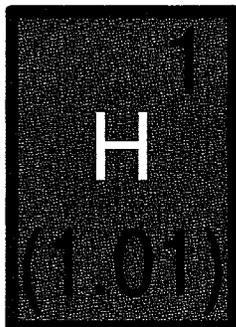


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# Recommendations for the Adoption of Uniform **Hydrogen and Fuel Cell Codes and Standards**

Submitted to the Minnesota Legislature  
by the Minnesota Department of Labor and Industry  
in consultation with the Minnesota Department of Commerce, Office of Energy Security

Dec. 31, 2008



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## Introduction

As of winter 2008, there are more than 60 hydrogen fueling stations in the United States, with 30 more stations planned or in the process of obtaining permits. Enough stations have been built that local jurisdictions do not have to reinvent the wheel.<sup>1, 2</sup>

In May 2007, Governor Pawlenty and the Minnesota Legislature adopted legislation requiring that the Department of Commerce and the Department of Labor and Industry (DLI) develop recommendations to facilitate the adoption of uniform codes and standards for hydrogen infrastructure, fuel cells and related technologies. This report identifies those recommendations along with a review of the status of existing hydrogen codes and standards in the state.

## Executive summary

The State of Minnesota regulates codes and standards in such a way that all regulatory jurisdictions in the state have the same safety standards with regard to the production, storage, transportation, distribution, use of hydrogen, fuel cells, and related technologies.

Except where amended, Minnesota codes and standards cover hydrogen and fuel cells by adoption of national codes and standards developed by the International Codes Council (ICC) and the National Fire Protection Association (NFPA).

A search of state code amendments that pertain to hydrogen indicates only a temporary conflict between the most recent editions and older adopted editions of two ICC codes. A rulemaking is currently in progress to adopt the most recent editions of these codes, effective June 1, 2009.

DLI has an existing annual training program for building officials. As this is already a part of DLI's business plan, no additional funding would be anticipated to present a seminar about hydrogen codes. Additionally, the Department of Energy can provide free training for local code officials and hydrogen facility developers who are working on permitting of specific proposed hydrogen fueling station or back-up power projects.

To formalize the use of the existing hydrogen codes, the state of Minnesota should evaluate the adoption of the NFPA's comprehensive Hydrogen Technologies Code (NFPA 2), once it becomes available in 2010.

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<sup>1</sup> National Hydrogen Association, Hydrogen Fueling Station Database  
<http://www.hydrogenassociation.org/general/fuelingSearch.asp>

<sup>2</sup> DOE Hydrogen Program, *Hydrogen Fueling – Coming Soon to a Station Near You*, Dec. 2007  
<http://www.nrel.gov/docs/fy08osti/40907.pdf>

## Statute language

2007 Minn. Laws, Chapter 57, Art. 2, Sec. 31:

Sec. 31. UNIFORM CODES AND STANDARDS FOR HYDROGEN, FUEL CELLS, AND RELATED TECHNOLOGIES; RECOMMENDATIONS AND REPORT.

(a) The commissioner of labor and industry, in consultation with the Department of Commerce and other relevant public and private interests, shall develop recommendations regarding the adoption of uniform codes and standards for hydrogen infrastructure, fuel cells, and related technologies, and report those recommendations to the legislature by December 31, 2008.

(b) The goal of the recommendations is to have all regulatory jurisdictions in the state have the same safety standards with regard to the production, storage, transportation, distribution, and use of hydrogen, fuel cells, and related technologies. The commissioner's recommendations must, without limitation, include:

(1) codes and standards that already exist for hydrogen, fuel cells, and related technologies, and how the state should formalize their use;

(2) codes and standards still under development by various official standard-making bodies;

(3) gaps between existing codes and standards, those under development, and those that may still be needed but are not yet being developed;

(4) the need for, and estimated cost of, additional education and training for emergency management and code officials;

(5) any changes needed to environmental and other permitting processes to accommodate the commercialization of hydrogen, fuel cells, and related technologies; and

(6) recommendations on appropriate codes and standards for educational and research institutions.

## 1. Existing

Hydrogen and Fuel Cell Codes and Standards are regulated at the federal level for transportation and electricity generation. Within the United States, building codes, fire codes, fuel codes, mechanical codes, and electric codes vary depending on state and local jurisdictions.

Except where amended, Minnesota codes and standards cover hydrogen and fuel cells by adoption of national codes and standards developed by the International Codes Council (ICC) and the National Fire Protection Association (NFPA). Both the ICC codes and the NFPA codes are certified by the American National Standards Institute (ANSI), meaning that they must be updated at least every five years.

Following are the codes and standards adopted by the state of Minnesota.

In 2007 Minnesota adopted the following International Codes Council (ICC) codes:

- The 2006 edition of the *International Building Code* (IBC) with state amendments (MN Rules, Chapter 1305),
- The 2006 edition of the *International Residential Code* (IRC) with state amendments (MN Rules, Chapter 1309)
- The 2006 edition of the *International Fire Code* (IFC) with state amendments (new MN Rules, Chapter 7511, next edition due in 2009)
- The 2000 edition of the *International Mechanical Code* (IMC) with state amendments (MN Rules, Chapter 1346) **2006 edition to be adopted effective June 1, 2009**
- The 2000 edition of the *International Fuel Gas Code* (IFGC) with state amendments (MN Rules, Chapter 1346) **2006 edition to be adopted effective June 1, 2009**

In 2008, Minnesota adopted:

- The 2008 edition of the *National Electrical Code* (as of Sept. 15, 2008), developed and published by the National Fire Protection Association, Inc., (ANSI/NFPA 70-2005), which is incorporated by reference and made part of the Minnesota State Building Code. (MN Rules, Chapter 1315)

### **State code amendments that pertain to hydrogen**

A search of state code amendments that pertain to hydrogen indicates only a temporary conflict between the most recent editions and older adopted editions of the two ICC codes.

The 2006 International Residential Code, sections 12 – 24, were replaced with the MN Mechanical and Fuel Gas codes, which are currently the 2000 editions of IMC and IFGC. As a consequence, Minnesota deletes IRC section M1307.4 (MN Rules 1309.0010 subp. 3.C.), which regulates hydrogen generating and refueling operations in private garages.

A rulemaking is currently in progress to adopt the 2006 editions of the IMC and IFGC, including the hydrogen provisions currently excluded from Minnesota codes (IMC 304.4 and IFGC 703). These are estimated to be adopted effective June 1, 2009. Docket information is available online at: [http://www.doli.state.mn.us/rulemaking\\_activity.html](http://www.doli.state.mn.us/rulemaking_activity.html), under rulemaking docket Chapter 1346.

### **State code regulation and application to local jurisdictions**

Building codes and standards are adopted at the state level by the Department of Labor and Industry. Minnesota Statutes 16B.62 requires that any building code enforced by a local jurisdiction must be the state building code.

Municipalities that have adopted the state building code as of Jan. 1, 2008 must continue to administer the code. The DLI Web site includes a list of municipalities that have adopted the State Building Code as of Jan. 1, 2008, at [http://www.doli.state.mn.us/pdf/code\\_list.pdf](http://www.doli.state.mn.us/pdf/code_list.pdf).

### **Other resources for identifying existing codes**

- DOE Hydrogen Program, *Hydrogen Fueling – Coming Soon to a Station Near You*, Dec. 2007 (<http://www.nrel.gov/docs/fy08osti/40907.pdf>) This fact sheet provides an overview of hydrogen fueling station permitting and includes a listing of several permitting official contacts for existing hydrogen fueling stations who are willing to share information about their permitting experience.
- The Department of Energy (DOE) *Permitting Hydrogen Facilities* Web site (<http://www.hydrogen.energy.gov/permitting/>) identifies model codes and standards to help local permitting officials deal with proposals for hydrogen fueling stations, fuel cell use for telecommunications facilities, and other hydrogen projects.
- NREL's *Hydrogen and Fuel Cells Codes and Standards Matrix* (<http://www.fuelcellstandards.com/>) Web site is a directory of all codes and standards worldwide dealing with hydrogen, fuel cells, and fuel-cell-related issues. It is maintained by the National Renewable Energy Laboratory (NREL).
- The American National Standards Institute (ANSI), *Hydrogen Codes and Standards Portal* (<http://hcsp.ansi.org/>) provides another online directory of existing hydrogen codes and standards from a variety of organizations such as the Society of Automotive Engineers (SAE), International Code Council (ICC), Compressed Gas Association (CGA), Underwriters Laboratories (UL), ANSI, etc.
- The US Department of Transportation *Hydrogen Portal to Safety Codes and Standards* (<http://hydrogen.dot.gov/safety/>) identifies additional resources for hydrogen codes and standards relating to transportation.

## 2. Under development

### ***How the state of Minnesota should formalize the use of existing hydrogen codes***

The National Fire Protection Association is developing NFPA 2 – the Hydrogen Technologies Code, a comprehensive hydrogen code that will consolidate all other existing NFPA hydrogen codes. NFPA 2 is intended to facilitate adoption of hydrogen codes and standards by state and local jurisdictions. Minnesota should evaluate adoption of the final edition of the NFPA 2 code when it becomes available in 2010.

#### **NFPA 2 - Hydrogen Technologies Code - will include:**<sup>3</sup>

- o NFPA 52 Vehicular Fuel Systems Code
- o NFPA 55 Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks
- o NFPA 853 Standard for the Installation of Stationary Fuel Cell Power Systems
- o NFPA 30A Code for Motor Fuel Dispensing Facilities and Repair Garages
- o NFPA 70 National Electrical Code
- o NFPA 88A Standard for Parking Structures
- o NFPA 497 Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
- o NFPA 86 Standard for Ovens and Furnaces 2003
- o NFPA 5000™ Building Construction and Safety Code
- o NFPA 1 Uniform Fire Code

### ***Other code development activities***

The DOE and industry stakeholders developed a *National Codes and Standards Template* ([http://www1.eere.energy.gov/hydrogenandfuelcells/codes/pdfs/cs\\_templates.pdf](http://www1.eere.energy.gov/hydrogenandfuelcells/codes/pdfs/cs_templates.pdf)) in 2003 to identify which organizations will lead and support the development of codes and standards that are required for hydrogen vehicle systems, on-site hydrogen generators, and stationary and portable fuel cells.

#### **Codes and standards issues addressed by the DOE:**<sup>4</sup>

- o Practical setback distances based on actual testing and performance. Existing set-back and other safety requirements can result in large footprints for hydrogen fueling stations.
- o General fuel cell vehicle safety
- o Developing test standard for vehicle on-board H2 storage
- o Fuel quality specification
- o Performance-based testing of fuel-station components (breakaways, fittings nozzles, and hoses)
- o Developing safety sensor performance targets
- o Modeling/simulation of leak scenarios in residential garages

EERE also identifies the standards development organizations ([http://www1.eere.energy.gov/hydrogenandfuelcells/codes/standards\\_organization.html](http://www1.eere.energy.gov/hydrogenandfuelcells/codes/standards_organization.html)) that are cooperating to develop hydrogen codes and standards. This site is especially useful for its use of full descriptions in addition to acronyms and initializations.

In addition to codes and standards development activities, there are several committees working together to reduce conflicts between new codes created by the various code development

<sup>3</sup> Hall, Karen, *NFPA 2 Hydrogen Technologies Code Technical Committee Meets*, National Hydrogen Association, Nov. 2006, <http://www.hydrogenandfuelcellsafety.info/2006/nov/nfpa2.asp>

<sup>4</sup> Burgess, Robert, et al., *Hydrogen Codes and Standards*, DOE Hydrogen Program, 2008 Annual Merit Review Proceedings, June 12, 2008, [http://www.hydrogen.energy.gov/pdfs/review08/scs\\_1\\_burgess.pdf](http://www.hydrogen.energy.gov/pdfs/review08/scs_1_burgess.pdf)

organizations. The two primary committees working toward this effort are the Hydrogen Industry Panel on Codes (HIPOC) and the National Hydrogen and Fuel Cells Codes and Standards Coordinating Committee (HFC4).

#### **Hydrogen Industry Panel on Codes (HIPOC)**

ICC and NFPA are collaborating with the National Renewable Energy Laboratory (NREL) in a Hydrogen Industry Panel on Codes (HIPOC) to develop and harmonize hydrogen codes and standards that affect or relate to the storage, dispensing, use and handling of hydrogen in and around fixed-facility applications, including service stations, parking garages, warehouses, loading areas and similar uses which support vehicular, distributed and portable power applications. Such provisions are to serve as a model for adoption and use by enforcement agencies at all levels of government in the interest of national uniformity.

More information on HIPOC activities is available on their Web site at [www.hydrogenandfuelcellsafety.info](http://www.hydrogenandfuelcellsafety.info)

#### **National Hydrogen and Fuel Cells Codes and Standards Coordinating Committee (HFC4)**

The National Hydrogen and Fuel Cells Codes and Standards Coordinating Committee (HFC4) is led by the U.S. Department of Energy (DOE), the National Hydrogen Association (NHA), the US Fuel Cell Council (USFCC) and NREL in collaboration with hydrogen industry stakeholders to facilitate the development of consensus-based codes and standards that are critical to ensure public safety and to accelerate the commercialization of new hydrogen and fuel cell technologies for stationary, transportation and portable applications.

The community of stakeholders includes codes and standards developers, industry members, technology developers, codes and standards users, architects and engineers, legislative and regulatory bodies that adopt codes, standards and other regulations, safety officials, first responders, and the US Government including the US Department of Energy (DOE), US Department of Transportation (USDOT), US Environmental Protection Agency (US EPA), US Department of Commerce (US DOC, particularly the National Institute of Standards and Technology (NIST)), Office of Management and Budget (OMB), National Laboratories, hydrogen and fuel cell users and consumers, and others. International stakeholders shall also be taken into account where their products or services might serve the US market.

HFC4 maintains a matrix of ongoing and completed codes, standards and regulations, with status and contact information, available online at [www.fuelcellstandards.com](http://www.fuelcellstandards.com). More information on HFC4 activities and on hydrogen and fuel cell codes and standards activities worldwide is available on their Web site at [www.hydrogenandfuelcellsafety.info](http://www.hydrogenandfuelcellsafety.info).

#### **Other State and Local Jurisdictions actively incorporating Hydrogen Codes and Standards**

- **California**, like Minnesota, has adopted ICC and NFPA codes with state amendments. Other H<sub>2</sub> activities:
  - The California Fuel Cell Partnership has developed an *Emergency Response Guide for Fuel Cell Vehicles* ([http://www.fuelcellpartnership.org/resource-ctr\\_ermaterials.htm](http://www.fuelcellpartnership.org/resource-ctr_ermaterials.htm)) for the purpose of sharing information about responding to emergency situations involving fuel-cell powered light-duty vehicles and transit buses, and hydrogen fueling stations.
  - California has 28 public and private access hydrogen vehicle fueling stations operating and 18 in the planning stages. Stations are concentrated in the two most-populated regions: the San Francisco-Sacramento corridor and in the great Los Angeles and San Diego regions<sup>5</sup>.

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<sup>5</sup> National Hydrogen Association, *Hydrogen Fueling Station Database*  
<http://www.hydrogenassociation.org/general/fuelingSearch.asp>

- **Michigan** is unique in that it has developed its own set of hydrogen standards. Some congressionally directed funding has gone to several activities in the state, including an annual conference on hydrogen codes and standards. Selected activities<sup>6</sup>:
  - Sept. 17 and 18, 2008: DOE Hydrogen Fueling Station and Fuel Cells-for-Backup-Power Permitting Process Workshop
  - Sept. 18 and 19, 2008: NextEnergy Annual H<sub>2</sub> C&S Conference in Detroit
  - Seven hydrogen vehicle fueling stations in the Detroit metro area – all private access only<sup>5</sup>
  - Fuel cell back-up power for cell phone towers
  - *Advancing Hydrogen in Michigan Working Group* (disbanded after having met its chief objective)
  - NextEnergy database of hydrogen permitting officials.
- **South Carolina** will host 2009 Nat'l H<sub>2</sub> Conference.
- **Other states with hydrogen fueling stations<sup>5</sup>:**

Arizona	Indiana	Nevada
Colorado	Massachusetts	Ohio
Connecticut	Missouri	Pennsylvania
Delaware	North Carolina	South Carolina
Florida	North Dakota	Virginia
Hawaii	New Mexico	Vermont
Illinois	New York	Washington, D.C.

### 3. Gaps

The following gaps were identified by NREL staff:

- Parking and other access restrictions: Complete access to parking, tunnels and other enclosed spaces has not yet been secured.
- Listing and labeling: New technologies not yet listed or labeled by a nationally recognized testing laboratory may have difficulty in obtaining reasonably priced insurance.
- The status of ongoing gap identification activities and the code development process in general can be monitored by checking meeting minutes of the HFC4.

### 4. Education and training needs and cost

DLI's Construction Codes and Licensing Division (CCLD) sponsors spring and fall seminars each year for municipal building officials at 12 locations around the state. When needed, DLI develops seminars based on the imminent adoption of new codes to ensure the building officials around the state are aware of the new code requirements.

CCLD has sponsored joint seminars with the State Fire Marshals office in the past and can make arrangements to provide both building and fire officials with a joint training seminar on hydrogen codes. In addition, the electrical unit of the CCLD could participate in a joint seminar.

The seminars are part of the business plan for the CCLD. The cost to the attendees is minimal, currently \$35 for a full-day seminar. No additional funding is anticipated to present a seminar on hydrogen codes.

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<sup>6</sup> NextEnergy, <http://www.nextenergy.org>

A wide variety of training resources are available online for the education and training of emergency management and code officials.

The DOE's *Hydrogen Safety Best Practices Manual* (<http://h2bestpractices.org/>) is an online manual that captures the wealth of knowledge and experience related to the safe handling and use of hydrogen that exists as a result of its extensive history in a wide variety of applications. The purpose of the manual, prepared collaboratively by the Pacific Northwest National Laboratory and Los Alamos National Laboratory, is to share this knowledge gathered from numerous experts, public domain documents, and references in an online, easy-to-use manner.

The DOE's *Introduction to Hydrogen Safety for First Responders* ([http://www.ehammertraining.us/energy/h2\\_login/login.cfm](http://www.ehammertraining.us/energy/h2_login/login.cfm)) is a Web-based course that provides an "awareness level" overview of hydrogen for fire, law enforcement, and emergency medical personnel. This multimedia tutorial acquaints first responders with hydrogen, its basic properties, and how it compares to other familiar fuels; hydrogen use in fuel cells for transportation and stationary power; potential hazards; initial protective actions should a responder witness an incident; and supplemental resources including videos, supporting documents, and links relevant to hydrogen safety. [Abridged versions of the course are in print and on CD via DOE's Energy Efficiency and Renewable Energy Information Center (<http://www.eere.energy.gov/informationcenter/>) and at 877-EERE-INFO/877-337-3463.]

The California Fuel Cell Partnership has also developed an *Emergency Response Guide for Fuel Cell Vehicles* ([http://www.fuelcellpartnership.org/resource-ctr\\_ermaterials.htm](http://www.fuelcellpartnership.org/resource-ctr_ermaterials.htm)) for the purpose of sharing information about responding to emergency situations involving fuel cell-powered light-duty vehicles, and transit buses, and hydrogen fueling stations.

The *Regulators' Guide to Permitting Hydrogen Technologies* ([http://www.pnl.gov/fuelcells/permit\\_guide.stm](http://www.pnl.gov/fuelcells/permit_guide.stm)) was developed through a collaborative effort involving the National Fire Protection Association (NFPA), the International Code Council (ICC), Pacific Northwest National Laboratory (PNNL), and the National Renewable Energy Laboratory (NREL). It provides basic information about hydrogen's use as a fuel, information on the regulatory process and relevant codes and standards for stationary fuel cell technologies for commercial buildings and hydrogen motor fuel dispensing facilities. The following documents are available as Adobe Acrobat PDFs.

- o Regulators' Guide to Permitting Hydrogen Technologies-Overview ([http://www.pnl.gov/fuelcells/docs/permit-guides/overview\\_final.pdf](http://www.pnl.gov/fuelcells/docs/permit-guides/overview_final.pdf))
- o Module 1 - Permitting Stationary Fuel Cell Installations ([http://www.pnl.gov/fuelcells/docs/permit-guides/module1\\_final.pdf](http://www.pnl.gov/fuelcells/docs/permit-guides/module1_final.pdf))
- o Module 2 - Permitting Hydrogen Motor Fuel Dispensing Facilities ([http://www.pnl.gov/fuelcells/docs/permit-guides/module2\\_final.pdf](http://www.pnl.gov/fuelcells/docs/permit-guides/module2_final.pdf))

*Hydrogen Fueling Station and Fuel Cells-for-Backup-Power Permitting Process Workshop*

The DOE, NREL, NHA, and USFCC are contracting with the National Association of State Fire Marshalls to train local code officials and hydrogen facility developers on hydrogen project permitting for states working on permitting of hydrogen fueling station or back-up power projects.

- o Workshops held in Atlanta (Jul 07), Santa Ynez / Buelton, CA (Mar 08), NYC-NJ (May 08) ; Detroit (Sept 08); and Southern California (2008)
- o Plans to conduct additional permitting workshops in FY09.
- o These workshops are funded by the DOE and there is no cost for attendance.

## 5. Permitting process changes needed to facilitate commercialization

The legislation requires DLI and DOC to identify any changes needed to environmental and other permitting processes to accommodate the commercialization of hydrogen, fuel cells and related technologies.

Pollution Control Agency (PCA) Staff were contacted concerning environmental and permit processes regulated by the Agency. The PCA does not have any statutes or rules that apply specifically to hydrogen, fuel cells or related technologies, such as for fueling stations. Staff noted only that regulations of on-site fuel storage and emissions may apply to a specific facility if other fuels used to produce hydrogen are incorporated at the facility.

Obtaining insurance could be a barrier. Interaction and dialogue with insurance agencies about characteristics of other hydrogen facilities in the U.S. may assist with project implementation.

## 6. Codes and standards for educational and research institutions

The legislation requires DLI and DOC to make recommendations on appropriate codes and standards for educational and research institutions.

Educational and research institutions are covered by existing codes. The current codes address the production, storage and use of hydrogen in building occupancy groups of all types. The codes for educational and research institution groups are included and are classified in a manner relative to other occupancies for the hazard to the occupants based on the presence of hydrogen production, storage and use.

## Other resources

DOE Hydrogen Program, *Hydrogen Fueling – Coming Soon to a Station Near You*, Dec 2007 <http://www.nrel.gov/docs/fy08osti/40907.pdf> This fact sheet provides an overview about hydrogen fueling station permitting and includes a listing of several permitting official contacts for existing hydrogen fueling stations who are willing to share information about their permitting experience.

### **DOE, EERE alternative fuels station locator**

[http://www.afdc.energy.gov/afdc/stations/find\\_station.php](http://www.afdc.energy.gov/afdc/stations/find_station.php)

### **National Hydrogen Association, Hydrogen fueling station database**

<http://www.hydrogenassociation.org/general/fuelingSearch.asp>

**State fuel cell and hydrogen database** - a searchable database of state programs, policy, incentives, initiatives, stationary fuel cell installations, vehicle demonstrations and hydrogen fueling stations is online at <http://www.fuelcells.org/info/statedatabase.html>.

**Stationary fuel cell installation database** <http://www.fuelcells.org/info/databasefront.html>