

**Status of
Codes & Standards
to enable a Hydrogen Economy**

HTAC July 2007

[reflects consensus developed by GM, APCI, Shell, DoE, UTC]

Codes & Standards

❖ Standard

-- a document with technical requirements and recommended practices

❖ Code

-- a document which covers a broad range of facility requirements such as required safety systems, installation & monitoring requirements, and further safety provisions (e.g. separation distances, safety zone classifications, ...)

Codes & Standards

❖ Standard

- a document with technical requirements and recommended practices
 - written for components or systems or combinations thereof
 - apply to design, service conditions, performance and validation testing
 - provide assurance of performance in normal and extreme conditions
 - established by SDOs (standard development organizations; e.g., ASME, ASTM, CGA, CSA, SAE, ISO..)
 - “listed” equipment → compliance verified by third party (UL, CSA...)

❖ Code

- a document which covers a broad range of facility requirements such as required safety systems, installation & monitoring requirements, and further safety provisions (e.g. separation distances, safety zone classifications, ...)
 - can be adopted directly into law
 - refers to Standards for requirements on equipment and systems
 - provide assurance of safety in normal and extreme conditions
 - established by CDOs (code development organizations; e.g., NFPA, ICC)
 - used as criteria for installation & operating permits by local AHJs (Authorities Having Jurisdiction) for stationary facilities

Over the last four years, we made significant progress
... *in adapting & establishing Codes for hydrogen facilities*

NFPA *National Fire Protection Association: www.nfpa.org*

- ✓ **1: Uniform Fire Code**
 - *general fire code*
 - *includes provisions for presence of flammable gases*
- ✓ **2: Hydrogen Technologies Code (new)**
 - *collection of the requirements for hydrogen facilities in the multiple NFPA Codes*
- ✓ **52: Vehicular Fuel Systems Code**
 - *includes requirements for service facilities (repair of gaseous fuel systems)*
 - *includes requirements for non-OEM CHG vehicles*
- ✓ **55: Compressed Gas and Cryogenic Fluids**
 - *requirements for equipment, systems and siting of pressurized storage and fuel handling*
- ✓ **70: National Electric Code**
 - *general electrical code*
 - *includes provisions for presence of flammable gases*
- ✓ **5000: Building Construction and Safety Code**
 - *requirements for hydrogen storage and handling within buildings*



... *effort needs to continue for another two years to get fully desired results*
(3-year revision cycle: ~2-year process for proposal adoption)

Over the last four years, we made significant progress
... *in harmonizing “competing” Codes for hydrogen facilities (HIPOC)*

ICC *International Code Council: www.iccsafe.org*

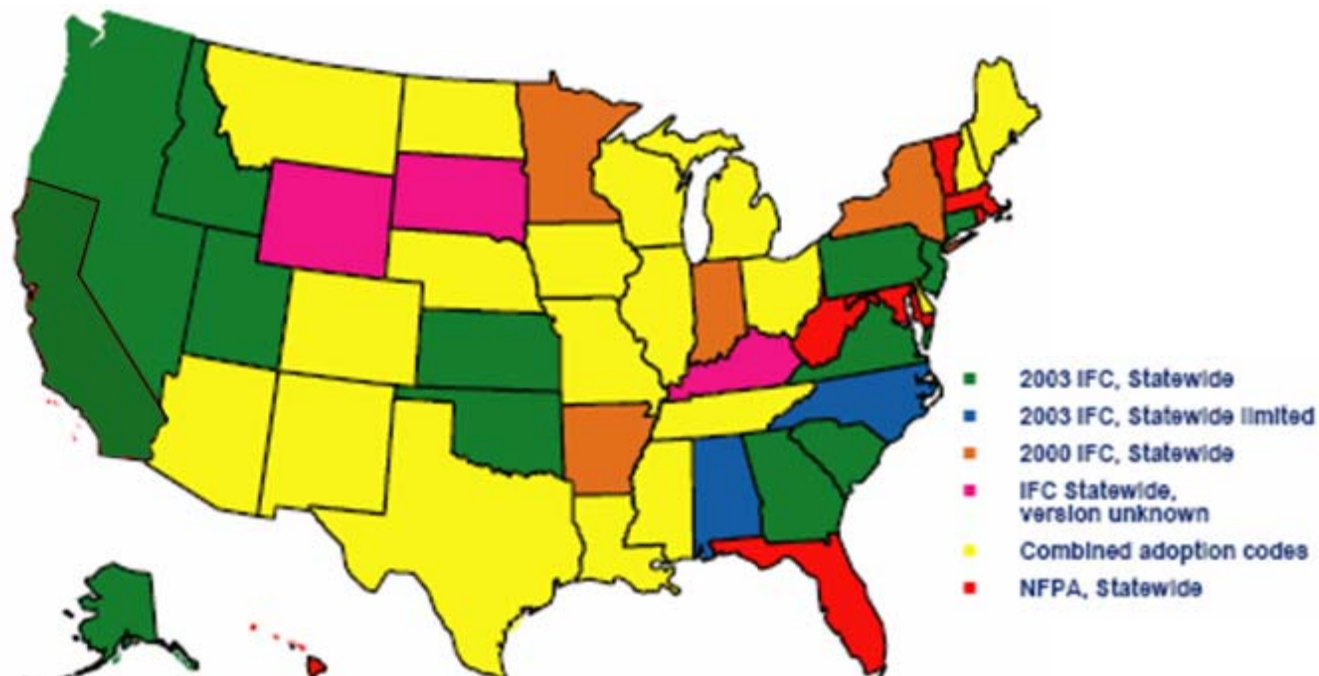
- ✓ **IFC: International Fire Code**
 - *general fire code*
 - *includes provisions for presence of flammable gases*
 - *requirements for gas and liquid hydrogen supply systems*
- ✓ **IFGC: International Fuel Gas Code**
 - *hydrogen used as a fuel gas*
- ✓ **IBC: International Building Code**
 - *requirements for hydrogen storage and handling within buildings*
- ✓ **IMC: International Mechanical Code**
 - *pipng requirements*

... and in harmonizing “competing” Standards

(stationary hydrogen storage & fuel systems, fuel dispensers, fueling stations, fuel quality, fuel flow & chemical measurements, component & system verification test methods ...)

- New editions of NFPA & ICC Codes include hydrogen facilities
 - most State Codes have not yet upgraded to the new editions.
- Most AHJs are not aware of new hydrogen Codes and/or have no experience applying them

Fire Code Adoption by State



What is Different from 10 years ago ? (siting of fueling stations)

1990s –

- C&S not written
- AHJs without experience
- Permit applicants without experience
- Several years lead time for approval to begin construction

2007 –

- C&S established
- AHJ training workshops initiated by DOE & State agencies
- AHJs learn from track record of early facilities
- Permit applicants
 - experience & lessons learned (documents & local needs; AHJs)
 - staff dedicated to duration of permit solicitation
- ~1 year for approval to begin construction

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- Governments engaged in research & demonstrations to substantiate Code and Standard revisions
 - Industry: expertise dedicated to Code & Standard development & harmonization

What is Not Different?

(targeted improvements)

❖ **CODES & STANDARDS**

- Composite tanks not allowed in fueling stations
- Instances of inappropriate carry-over of CNG requirements to CHG Codes
 - Odorization
 - Detection
 - Separation distances
 - Ground contamination
- SAE/CSA & ISO Standards for vehicle storage & fueling incomplete

❖ **STATE AND FEDERAL REGULATIONS**

- Awaiting revision of State Building & Fire Codes
- Awaiting establishment of federal requirements for portable hydrogen-fueled devices on airplanes
- Awaiting revision of federal requirements for transport of hydrogen cargo
- Awaiting UN-GTR/FMVSSs for vehicle safety

PRIORITIES

- **Training for permitting authorities & first responders**
 - DOE training materials & experts
 - Availability of installed demonstration sites
 - Resource pool from companies involved in demonstrations
- **Managed liability while track record develops**
 - Get components & systems listed to standards
 - Develop government constraints on liability

Challenge for Emergence of Hydrogen Economy = Experience not appreciated

- 100s of LH installations
- 100s of miles of pipelines
- Self regulating industry
- Dozens of fueling stations
- 1000s of reliable fills
- Indoor experience



Congressional Record 1875

A new source of power...called gasoline has been produced by a Boston engineer. Instead of burning the fuel under a boiler, it is exploded inside of the cylinder of an engine....

The dangers are obvious. Stores of gasoline in the hands of people interested primarily in profit would constitute a fire and explosive hazard of the first rank. Horseless carriages propelled by gasoline might attain speeds of 14, or even 20 miles per hour. The menace to our people of this type hurdling through our streets and along our roads and poisoning the atmosphere would call for prompt legislative action even if the military and economic implications were not so overwhelming....

The cost of producing [gasoline] is far beyond the capacity of private industry...

In addition the development of this new power may displace the use of horses, which would wreck our agriculture.