Hydrogen Workshop: *Understanding Hydrogen Energy Technologies*

The National Hydrogen Association

The 2005 Fuel Cell Seminar

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- How U.S. Model Codes apply to hydrogen energy technologies
  - Standards, Regulations, and Codes
  - NFPA
  - ICC

Codes, Standards, and Regulations

- *Main Entry: **1stan·dard***
  Pronunciation: 'stan-d&rd
  Function: noun
  ***:** something set up or established by an authority as a rule for the measure of quantity, weight, extent, value, or quality*
- *Source: Merriam-Webster's Medical Dictionary, © 2002 Merriam-Webster, Inc.*

Codes, Standards, and Regulations

- *Main Entry:* ***reg·u·la·tion***
  Function: noun
  1 : *the act of regulating or state of being regulated*
  2 : *an authoritative rule; specifically* ***:*** *a rule or order issued by a government agency and often having the force of law —see also Administrative Procedure Act in the IMPORTANT LAWS section*
  NOTE: An agency is often delegated the power to issue regulations by the legislation that created it. Regulations must be made in accordance with prescribed procedures, such as those set out in the federal or a state Administrative Procedure Act. Federal regulations are first published in the Federal Register and later codified in the Code of Federal Regulations.
- *Source: Merriam-Webster's Dictionary of Law, © 1996 Merriam-Webster, Inc.*

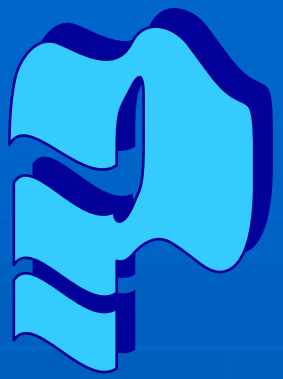
Codes, Standards, and Regulations

- Main Entry: **code**
  Function: *noun*
  Etymology: Old French, from Medieval Latin *codex*, from Latin *caudex codex* tree trunk, set of wood writing tablets, book
  1 : a systematic compilation or revision of law or legal principles that is arranged esp. by subject: as **a :** one that contains the law of a specific jurisdiction or topic promulgated by legislative authority <U.S. *Code*> <*Code* of Massachusetts Regulations> <building *code*> —see also IMPORTANT LAWS in the back matter —compare CASE LAW, DIGEST, STATUTE **b :** one that serves as a model for legislation but is not itself a law <Model Penal *Code*>
  2 : a set of rules or regulations that is promulgated by a body (as a professional organization) and that regulates its industrial or professional practices <ABA *Code* of Professional Responsibility>

- Source: *Merriam-Webster's Dictionary of Law, © 1996 Merriam-Webster, Inc.*

Authorities Having Jurisdiction

- Approvals of local authorities, such as building inspectors, Fire Marshals, etc., are required for installation.
- Fire Codes, Fuel Gas Codes, Building Codes, Mechanical Codes, Plumbing Codes, Electrical Codes, etc.
- State, County, City authorities involved.
- Codes in use vary between jurisdictions.
- AHJs look to the codes for guidance and compliance provisions.



Is this application covered by the code? If so, does it comply? If not, does that mean it is OK, or unacceptable?



Hydrogen Properties

- Energy Content: 60,958 Btu/lb – highest energy content of all fuels on a **weight** basis
  - This is why NASA uses hydrogen – they care a lot more about weight than volume
  - Energy content is about three times higher than gasoline, natural gas, and propane on a **weight** basis
  - Energy content is only about one third that of natural gas and about an eighth that of propane on a **volume** basis
- Flammability limits (in air): 4.1 v% - 74 v%
- Explosion limits (in air): 18.3 v% - 59 v%
- High diffusivity
- High buoyancy

Hydrogen Safety

- Regulated as Hazardous material under DOT
- OSHA regulations for storage of gaseous and liquid hydrogen (extracted from 1973 editions of NFPA 50A and 50B)
- Major national effort to develop required regulatory structure for hydrogen
- NFPA and ICC are very involved in this effort

US Model Code Provisions

- International Code Council – recently addressed
  - Gaseous Canopy Top Storage
  - Underground Liquid Storage
  - Metal Hydrides
  - Testing, Inspection and Purging of Hydrogen Piping Systems
- NFPA – under review
  - NFPA 52: Vehicular Fuel System Code 2005 Edition
  - NFPA 55, Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks

NFPA – what it is and what it does

- Non Non-profit association founded in 1896
- Provides full range of fire and safety programs
- Develops codes & standards - volunteer based
- 75,000 Members & 300+ Staff
- 220+ Committees
- 300+ Codes & Standards
- www.nfpa.org
- www.nfpa.org/ECommittee/HCGroup/HCGroup.asp

The NFPA Process

- Revision process closely mirrors regulatory revision process
- Call for proposals
- Committee review of proposals
- Report on Proposals published
- Call for Comments/committee review
- Vote by NFPA membership
- Issuance of document by NFPA Standards Council

Recent NFPA Hydrogen Activities

- Expansion of NFPA 52 Compressed Natural Gas (CNG) Vehicular Fuel Systems Code 2002 - 2005 Edition covers Hydrogen.
- NFPA 55 Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks 2005 Edition
- *NFPA 853 Stationary Fuel Cell Power Plants* 2003 Edition
- NFPA 70 National Electric *Code*® Article 692 2005 Edition
- *NFPA 30A Code for Motor Fuel Dispensing* Facilities and Repair Garages 2003 Edition

More Recent NFPA Activities

- On August 25th, the NFPA's Standards Council issued the new edition of NFPA 52: Vehicular Fuel Systems Code: 2005 Edition.
- The standard NFPA 853: Standard for the Installation of Stationary Fuel Cell Power Plants is going through its normal revision process. The current version is the 2003 Edition.
- The Standards Council approved the recommendation to consolidate all of the hydrogen safety requirements in its various codes and standards documents into a single document that would tentatively be entitled NFPA 2 (Hydrogen Technology).

NFPA **Vehicular Alternative Fuels T/C**

- Primary responsibility for documents on fire and explosion hazards associated with compressed natural gas (CNG), gaseous hydrogen (GH2), liquefied hydrogen (LH2), and liquefied natural gas (LNG) engine fuel systems on vehicles of all types and for refueling stations and associated storage.
- Responsible for NFPA 52 and 57

Recent Code and Standard Activities - NFPA 853 2003 ed.

- 2003 is current edition of 853
- Covers all size stationary fuel cells- previous edition did not cover smaller systems
- Refers to NFPA 55 for storage of hydrogen used for fuel cell systems
- Committee met January 2005 to review proposals to 2006 edition of NFPA 853

NFPA Consolidation

- The Standards Council has received a proposal to consolidate all of the hydrogen safety requirements in its various codes and standards documents into a single document. The objectives in doing this would be to:
  - Increase ease of use
  - Facilitate harmonization of the safety requirements.
  - Consolidation would facilitate the process for making changes to existing requirements and formulating new ones as the hydrogen and fuel cell technologies evolve and as operating experience is gained. The proposal is for consolidating hydrogen safety requirements in NFPA 52, NFPA 55, NFPA 853, NFPA 30A, and NFPA 70 into a single document that would be entitled NFPA 2 (Hydrogen Technology).

NFPA Guidebook

- NFPA has just published a guidebook on gas safety that includes hydrogen:
  - The NFPA Guide to Gas Safety, Carl H. Rivkin, Editor, National Fire Protection Association, Quincy, MA, 2005.
- Hydrogen-related materials in the Guide include chapters on hydrogen fueling stations and what happens when hydrogen leaks develop.

International Code Council (ICC)

- The ICC was established in 1994 as a nonprofit organization dedicated to developing a single set of comprehensive and coordinated national model construction codes. The founders of the ICC are Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International, Inc. (SBCCI). Since the early part of the last century, these nonprofit organizations developed three separate sets of model codes used throughout the United States. Although regional code development has been effective and responsive to our country's needs, the time came for a single set of codes. The nation's three model code groups responded by creating the International Code Council and by developing codes without regional limitations the International Codes.

International Code Adoptions *(Inclusive of hydrogen provisions)*

- 2003 IBC, IFC, IRC, IMC, IFGC editions include reasonable and contemporary hydrogen provisions
- 2006 International Codes even better (Available Jan. 2006)
- 241 jurisdictions adopted I-Codes during the first six months of 2005
- At least one of the International Codes now the choice of public safety officials in all 50 states
  - California (2003 IBC, IFC, IRC)
  - Oregon (2003 IFC)
  - Phoenix, AZ (2003 IBC, IRC, IMC)
  - South Carolina (2003 IBC, IFC, IRC, IMC, IFGC)
  - Utah (2003 IBC, IFC, IRC, IMC, IFGC)
- Unified Facilities Criteria for US Department of Defense
- New York City *(still working)*

Ad Hoc Committee for Hydrogen

- Public Hearings, March 2005 (Cincinnati, OH)
  - Separation Distances Barrier Walls — APPROVED
  - Indoor Refueling & Lift Trucks — APPROVED
  - Clarity in Hydrogen Cutoff Rooms — APPROVED
  - Canopies (Auto- v. Manual-) Discharge — DISAPPROVED
  - Flammable Gas Detection — APPROVED
  - Underground LH2 Seismic — APPROVED
  - Eliminate "Closed Systems" Ambiguity — APPROVED
  - H_2 Piping Improvements — APPROVED
  - Metal Hydride Systems — DISAPPROVED
- Nearly 80% Success Rate

Future Work Affecting Hydrogen in the U.S. Model Building Codes

- Focus for the remaining effort (thru 2004/05 Cycle & 2006 Editions)
  - Sept/Oct 2005, Final Action Hearings (Detroit, MI)
    - Defend positions of the AHC
    - Provide a source for information
  - AHC Dies A Peaceful Death October 2nd, 2005

- **H**ydrogen & **F**uel **C**ells **I**ndustry **P**anel **O**n **C**odes
  - **HFC-IPOC** to extend activities formerly with AHC
  - Uninterrupted flow of work
  - Mechanism to coordinate ICC and NFPA on hydrogen by 2009
  - Planned Meetings
    - Jan or Feb, 2006, (Birmingham, AL)
    - March 24, 2006, Deadline for Proposed Changes
    - July 2006, Proposed Changes Monograph
    - Sept. 14-20, 2006, ICC Public Hearings (Orlando, FL)

- Increase Awareness of Hydrogen as an Energy Carrier Among U.S. Building, Fire Safety and Fire Operations Professionals

Summary

- The US Model Codes are incorporating provisions for hydrogen energy systems.
- Both NFPA and ICC have a process for proposals, review, and approvals.
- Industry can participate in the process to make the codes more inclusive of current and planned hydrogen energy systems, increasing likelihood of AHJ approvals.



Q&A