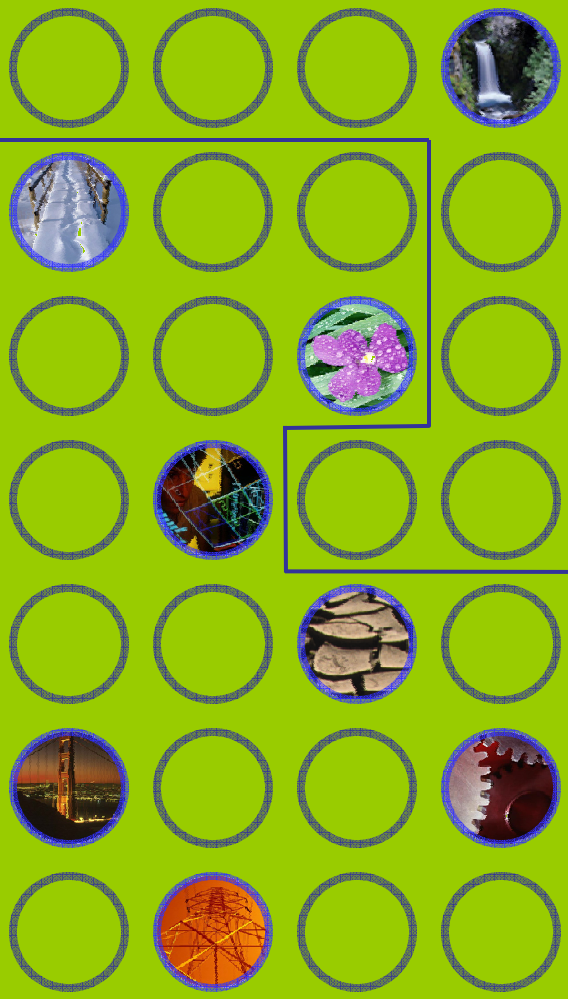

Hydrogen Fuel Cell Codes & Standards

HTAC

October 15, 2010

When You Can't Afford To Be Without Power

Company Profile

- Incorporated 1995
  - Initial private funding: 2003
  - Headquarters: Spokane, WA
- 46 employees
- Strong intellectual property portfolio
- Commercial products deployed since 2003 with more than 100 customers
  - Over 3,000kW at ~1,100 sites
- Supply contracts established with all major U.S. telecom operators
- Strategic relationships in place with major power systems integrators
- Multiple ongoing R&D projects
  - Conductive Ceramic Technology
  - Polymer & Catalyst technology
  - Hydrogen storage & generation

MODULAR CARTRIDGE TECHNOLOGY

Fact of Life

- ReliOn Inc. adheres to many codes, standards and certifications.
- Our business is dictated by regulation.

MODULAR CARTRIDGE TECHNOLOGY

Codes and Standards: Design

- NFPA Standards:
  - **70**: National Electric Code
  - **496** Standard for Purged and Pressurized Enclosure for Electrical Equipment, 1998
  - **497** Recommended Practice for the Classification of Flammable Liquids, Gases or Vapors and of Hazardous Locations for Electrical Equipment, 1998
- CGA:
  - **E – 11** Standard for Stationary Compressed Cylinder Discharging Manifolds for Working Pressures up to 3000 PSI
  - **G – 5.4** Standard for Hydrogen Piping systems at consumer Locations
- ASME/ANSI
  - **B31.3** – Process Piping Code
- ANSI/CSA:
  - **FC1** – Standard for Stationary Fuel Cell Power Systems
- NEBS:
  - **GR 487, GR 1063, & GR 1089**

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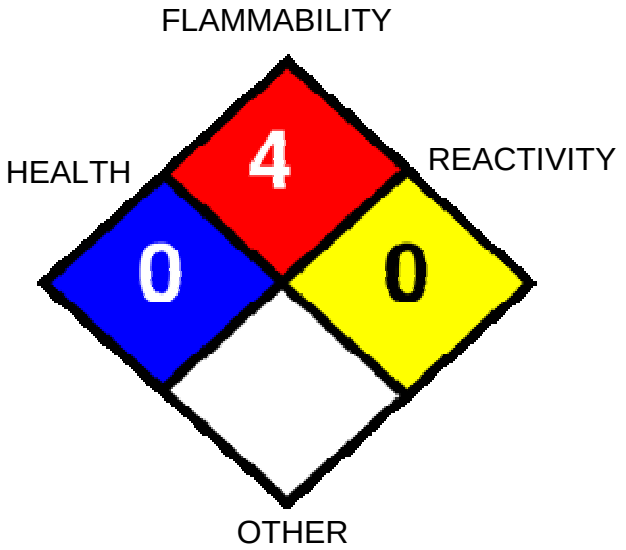
Codes and Standards: Installations

- NFPA Standards:
  - **853**: Standard for Installation of Stationary Fuel Cell Power Plants, 2003
  - **55**: Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks, 2005
  - **NFPA 70A**: National Electric Code
- IFC/IBC Codes:
  - Ch. 27 Hazardous Materials – General (Table 2703.1.1)
  - Ch. 35 Flammable Gases (Table 3504.2.1)
- Codes focused around:
  - Fuel storage setback distances
  - Gas/electrical safety

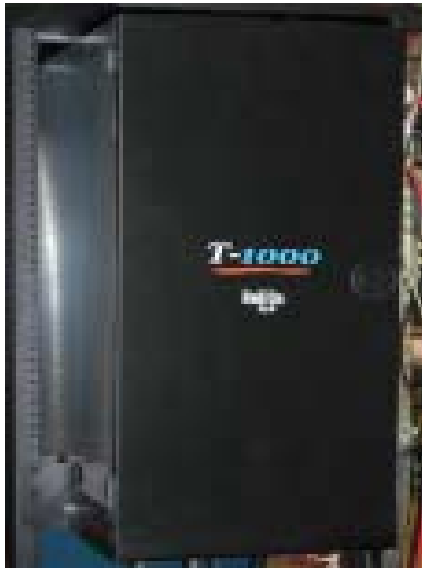
Permitting

- Authority Having Jurisdiction (AHJ)
  - Federal, State, County, or Municipality
  - Fire Marshal and/or other permitting agency
    - Planning/Zoning/Building/Fire
- Primarily Looking for:
  - Listed commercial equipment
    - UL or CSA Listed
  - Safe Installation Practices
    - Adequate access to cabinet
    - Proximity to known spark sources
    - Likelihood of hazardous situations



NFPA 704 HAZARD DIAMOND
FOR HYDROGEN

Indoor Applications



- The systems are Listed by UL and CSA for indoor applications using the appropriate recognized and listed components as required by the standard.
- The systems are certified to ANSI/CSA FC 1 - 2004 “Stationary Fuel Cell Power Systems.”
- The units are also CE certified by the notified body of GASTEC Certification BV.
- File Numbers are:
  - Underwriters Laboratory: E215217
  - Canadian Standards Association: 212221
  - Gastec Report Number: 123289.010
- The UL & CSA listings cover the fuel cell system product, including the insulating shell and low pressure regulator.

MODULAR CARTRIDGE TECHNOLOGY

Outdoor Application

- The units are Listed by UL and CSA for direct outdoor applications using the appropriate recognized and listed components as required by the standard.
- It is certified to ANSI/CSA FC 1 -2004 "Stationary Fuel Cell Power Systems."
- File Numbers are:
  - Underwriters Laboratory: E215217
  - Canadian Standards Association: 212221
- The UL & CSA listings cover the fuel cell system product, including the insulating fuel cell cabinet and low pressure regulator.

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NEBS Compliant Systems

- Test to Verizon TPR:
  - VZ.TPR.9801 Fuel Cell Systems NEBS Testing Requirements
- Systems must incorporate ANSI/CSA FC 1-2004 listed fuel cell systems
- NEBS testing includes outdoor enclosures and fuel storage cabinets

1.2kW 1-meter
Outdoor Enclosure

1.2kW Extended Run
Outdoor Enclosure

T-1000® Fuel Cell Systems

NEBS Compliant Systems (continued)

4-kW Outdoor Enclosure

6-kW Outdoor Enclosure

T-2000® Fuel Cell Systems

MODULAR CARTRIDGE TECHNOLOGY

Certification Compliance

- NEBS certified solutions
- CSA
- CE
- UL
- FCC
- Field proven operation

NEBS Cold Weather Operation

NEBS Brushfire Testing

MODULAR CARTRIDGE TECHNOLOGY

Equipment Siting Recommendations

- ReliOn Permitting Guide
  - Based upon recognized standards combined with ReliOn's knowledge of the industry and the properties of the fuel.
- Hydrogen Executive Leadership Panel (HELP) Sheet
  - Set Backs based upon IFC/IBC and manufacturers' recommendations
  - ReliOn's Set Back recommendations are based on this compilation of data.

MODULAR CARTRIDGE TECHNOLOGY

Site Evaluation Worksheet

Site Evaluation Worksheet for Flammable Gas Storage
Stationary Hydrogen Fuel Cells

2006 editions of the International Building Code, International Mechanical Code and International Fuel Gas Code, which have references to the International Fire Code.

Typical hydrogen storage siting criteria for quanitities less than 4,226 standard cubic feet (scf) and 4,226 to 21,125 scf. Interpretation by the Authrority Having Jurisdiction (AHJ) will determine final setback distances.		Controlling Code	Setback <4,226 scf	Setback 4,226 to 21,125 scf
Buildings on the same property[c]	Non-rated construction or openings within 25 ft	IFC Table 3504.2.1	5 ft	10 ft
	2-hour construction and no openings within 25 ft	IFC Table 3504.2.1	0 ft	5 ft
	4-hour construction and no openings within 25 ft	IFC Table 3504.2.1	0 ft	0 ft
Underground flammable or combustible liquid storage, distance to vent or fill opening[b]		Recommend	5 ft	10 ft
Ignition sources (including appliance burner igniters, hot work and hot surfaces capable of igniting flammable vapors)[b]		Recommend	5 ft	10 ft
Overhead electric utilities[b]	Overhead electric wire	Recommend	5 ft	10 ft
	Overhead bus, trolley or train wire	Recommend	5 ft	10 ft
Public streets, public alleys or public ways [a,c]		IFC Table 3504.2.1	5 ft	10 ft
Distance to lot lines of property that can be built upon [a,c]		IFC Table 3504.2.1	5 ft	10 ft
Dry vegetation and combustible materials[c]		IFC 2703.12 / 2704.11	15 ft	25 ft
Above ground flammable or combustible liquid storage[b]	Diked, distance to dike	Recommend	5 ft	10 ft
	Not diked, distance to tank	Recommend	5 ft	10 ft
Additional flammable gas storage areas[c]		IFC Table 3504.2.1	5 ft	10 ft

a. The minimum required distances shall not apply when fire barriers without openings or penetrations having a minimum fire-resistance rating of 2 hours interrupt the line of signt between the storage and the exposure. The configuration of the fire barrier shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.
b. These distances are recommended based upon the distances contained within IFC Table 3504.2.1.
c. These distances are specified in the International Fire Code, 2006 edition.

Revision Date: June 25, 2010

Figure 5-1 Hydrogen Setback Distances

MODULAR CARTRIDGE TECHNOLOGY

Issues Experienced – Interpretations

- Not all AHJ's use the same references
  - NFPA 55
  - International Building Code (IBC)
  - International Fire Code (IFC)
- No arbitration possible if AHJ misinterprets code language; even when faced with the facts
  - "Letter of the law" vs. "intent of the language"
- MAQ, 'Maximum Allowable Quantity'…Code interpretation
  - IFC 3504.2.1 clearly describes how to handle large quantities

Interpretations – con't.

- Most AHJ's lack experience with Hydrogen
  - Fear of the Unknown; Hindenburg or mushroom cloud!
  - Some treat installs as "Science Projects" vs. commercial deployments
  - Uninformed/conservative interpretations lead to non-value-added steps
    - Unnecessary pressure testing often requested
    - Proof of detailed internal component testing as if the apparatus was a custom
    - Not the same for Diesel / Propane Gen-Sets (unlevel playing field)
    - Require more inspections leading to higher install cost and project delays

Issues in Field – Other Challenges

- Southern California Edison – Electrical Utility
  - NIMBY
  - A member of California Hydrogen Business Council, but unwilling to allow hydrogen on any of their properties
- American Tower Company – Wireless Site Landlord
  - Excessive Set Backs
  - Interpretation of NFPA/OSHA standards drives them to enforce large H2 quarantine zones at their sites
  - Makes site rental economically infeasible for fuel cells

Storage allowances for Infrastructure Fuels

Fuel Type	Allowable onsite Storage Quantity/ BTU	Special Conditions
Diesel	275 gallons 139,000 BTU's/gallon **38,225,000BTU's/site**	Data from Table 4.3.2.1.1(a) and (b), NFPA 30 Flammable Liquids Code 2006
Gasoline	275 gallons 124,000 BTU's/gallon **34,100,000 BTU's/site**	Data from Table 4.3.2.1.1(a) and (b), NFPA 30 Flammable Liquids Code 2006
LPG	1200 gallons 91,600 BTU's/gallon **109,120,000 BTU's/site**	5 foot minimum between relief valve discharge and external source of ignition (air conditioner), direct vent, or mechanical ventilation system (attic fan).
Hydrogen	3400cuft 270 BTU's/cuft **945,000/site**	NFPA restricts proximity to occupied structures, ventilation ducts….

Allowable Hydrogen on site storage is at least one order of magnitude lower than other fuels by BTU content.

MODULAR CARTRIDGE TECHNOLOGY

Thank You

- Key Technical C&S Contact
  - Mike Maxwell
    Director of Applications Engineering
    ReliOn Inc
    509-228-6612
    mmaxwell@relion-inc.com

- Key Federal Sales Contact
  - Carter Marantette
    Director of Federal Sales
    ReliOn Inc
    571-926-9644
    cmarantette@relion-inc.com

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