US Fuel Cell Council

US Fuel Cell Council Codes & Standards Whitepaper

Fuel cells are consumer products, and since they are produced and used by the public, they are regulated by national and international product safety and consumer protection regulations.

Manufacturers of consumer products also typically follow a “common sense” approach to avoiding lawsuits whereby the standards of the industry are used as guidance for new offerings to avoid injury and damages.

Fuel cells are also used in and around public and private buildings where zoning laws and building regulations call for certain requirements to be met before a system can be approved for construction and use.

Fuel cells also use fuels that may be flammable or reactive and these fuels may be classified as hazardous. The use and storage of these fuels may be controlled by regulations that have been in place for years, restricting their use in new applications.

What Are Codes and Standards?

In the most basic sense, codes are laws. The Code of Federal Regulations, the Pennsylvania Vehicle Code, the Texas Civil Practice and Remedies Code, and the California Building Code are all laws. You must follow them, where applicable, or you are subject to legal penalties under the law. Codes are passed by legislatures and jurisdictions to control those things under their authority.

Standards are guidance, written by organizations set up for that purpose, that can be voluntarily followed to achieve standardization or a level of quality that is respected in a particular industry. In the United States, the American National Standards Institute (ANSI) was established in 1918 to coordinate the work of the major standards developing organizations at the time including the American Society of Mechanical Engineers (ASME), the American Institute of Electrical Engineers (now IEEE), the American Society of Civil Engineers (ASCE), the American Institute of Mining and Metallurgical Engineers (AIMME), and the American Society for Testing and Materials (ASTM) to “avoid duplication, waste, and conflict”. ANSI now serves as the sole U.S. representative to the two major non-treaty international standards organizations: the International Standards Organization (ISO) and the International Electrotechnical Commission (IEC). Standards literally apply to everything from chalk to cheese. Check out these two:

ASTM D4214-98 Title: Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films

ISO 11816-2:2003 Title: Milk and milk products — Determination of alkaline phosphatase activity — Part 2: Fluorometric method for cheese.

Codes and standards are sometimes confused with one another. Sometimes this confusion is done on purpose. For instance, standards developing organizations sell their work to interested parties for a price. Sales of standards is big business. Standards are sold to those wanting to follow the standards or make sure that others follow the standards for products that they are interested in. But what if the law required you to follow these standards? What if the law in New York or California or Hawaii required that both ASTM D4214-98 and ISO 11816-2:2003 be followed at all times? Wouldn't they sell a lot more of

those standards to people being careful to comply and checking up on those who did the work? Sure they would! So making a standard into a code - making it a law - is a good thing for sales.

For instance, let's talk about building codes. Most US jurisdictions have building codes. These are laws that tell people what can be built, where, and how. The smallest details are covered for all types of buildings. Fire ratings, number of exits, required ventilation, energy use, resistance to earthquakes and many other things are covered in detail. Writing these building codes is laborious and time consuming. Since a small town may not be able to take the time to write the documents themselves, they may use something written by others for the same purpose. They might ask to copy a building code used elsewhere, or they might use something written as a template for adoption. These templates for adoption are called “model building codes” and they are written for the purpose of adoption by local jurisdictions.

Probably the most famous example of a “model building code” is the National Electrical Code. The National Electrical Code is actually a standard. It is an ANSI Standard, written by the National Fire Protection Association (NFPA). The National Electrical Code (NFPA 70) is adopted into law by nearly all local jurisdictions in the United States, but until it is adopted into law it is just a standard. Wherever it is NOT adopted into law, other different rules may apply. Getting standards adopted as law – getting them codified – is the goal of every model code, but it is always best to check with the local jurisdiction to find out what applies, and not just use the titles of standards to make your choice of documents to follow.

What Codes and Standards do I have to follow to install a fuel cell project?

The simplest answer to that question is probably "You must follow the laws in force where the project will be built". For the rest of this discussion, the United States is used as an example. Other countries will have other requirements, of course.

In the United States, almost every location has a local building code that requires buildings and other structures to be designed and built safely, for the good of everyone. This is well known to construction professionals and is enforced by the typical requirement to obtain a building permit, have periodic inspections by the local Building Department or other authority having jurisdiction over the project and obtain a final permit to occupy or use the facility. Local jurisdictions have local deviations from the model building codes and sometimes deviations are applied on a use-by-use basis. Hospitals may have more stringent requirements than office buildings, for instance. Hazardous materials may require special construction or additional mitigation. It is important to discuss the actual legal requirements with the local officials who will be granting the building permit and enforcing the requirements, but some good guidance can be found at The National Conference of States on Building Codes and Standards (NCSBCS) <www.ncsbcs.org>. NCSBCS maintains a data base of all jurisdictions in the United States, and can tell you who is the proper authority having jurisdiction for whatever issue is at hand, wherever the project might be built. Additionally NCSBCS can provide the basis document or model building code or template for the various building codes in force. This will allow the project to find out if a newer model building code that includes requirements for fuel cells and hydrogen has been used as the basis for the local building code, or if they used an older model code that may not take fuel cells and hydrogen properly into account at all.

Once the authority having jurisdiction and the model building code are known, some things can be assumed, but it is always best to contact the authority having jurisdiction directly, since they will be making the final decisions. It is also wise to obtain a copy of the local construction codes or building standards to see if local deviations have properly taken hydrogen and fuel cells into account. A typical set of construction codes or building standards might include the following:

1) Building Code – including seismic and structural standards

2) Mechanical Code – including ventilation requirements

3) Plumbing Code – including fuel piping, water and waste piping, and process piping

4) Energy Code – including energy efficiency and insulation

5) Fire Code – including ventilation and fire protection requirements

6) Electrical Code – including wiring, hazardous locations and fire protection requirements

7) Administrative Requirements – including the requirements to obtain permits, environmental impacts, fees and inspection requirements

8) Air Quality Regulations – Including gaseous and particulate emissions

Fuel cells and hydrogen might be covered by any or all of these. An example of building code requirements for hydrogen fueling stations applicable in 2004 for California is given here: http://www.hydrogenhighway.ca.gov/implement/documents/laws.pdf

A good thorough discussion of fuel cell project regulatory requirements, plus a case study, can be found here: http://hcsp.ansi.org/pdf/module1a_final.pdf .

It should be noted by the user that the regulatory landscape is always changing. For instance, in the document referenced above, NFPA 50A and NFPA 50B are given as the *Standard for Gaseous Hydrogen Systems at Consumer Sites* and the *Standard for Liquid Hydrogen Systems at Consumer Sites,* respectively. Since the time the document above was published, those two standards have been consolidated into 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.* For the latest updates and latest topics on hydrogen and fuel cell standards, www.fuelcellstandards.com is an excellent resource.

As always, consultation with local building officials and authorities having jurisdiction is the best guide to the requirements at the project site, but for general guidance the following list of standards is recommended for review:

NFPA 54: National Fuel Gas Code

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

US Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR 1910 Subpart H – Hazardous Materials 1910.103 – Hydrogen

NFPA 853: Standard for the Installation of Stationary Fuel Cell Power Plants 2003 Edition

NFPA 70: National Electrical Code Article 692 Fuel Cell Systems

ANSI / IEEE 1547-2003: IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems

ANSI/CSA America FC1-2004 (formerly ANSI Z21.83) American National Standard For Fuel Cell Power Systems

IEC 62282-3-1: Fuel Cell Power Systems – Safety

Last Updated July 2007

American Society of Mechanical Engineers PTC 50: Performance Test Code, For Fuel Cell Power System Performance

IEC 62282-3-2 (2006-03): Fuel Cell Power System – Performance

International Code Council – Model Building and Construction Codes and Standards – www.iccsafe.org

National Fire Protection Association – Model Building and Construction Codes and Standards – www.nfpa.org

International Association of Plumbing and Mechanical Officials – Model Building and Construction Codes and Standards -- www.iapmo.org

What Codes and Standards apply to portable fuel cells?

The discussion of stationary fuel cells above doesn't cover portable fuel cells. Portable fuel cells are smaller, mobile, and may not be covered by building regulations at all. So how do we know that they are safe? The manufacturer bears the ultimate responsibility for the safety of their product. In a litigious environment, an unsafe product will be forced off the market quickly by lawsuits. In the United States, the US Consumer Product Safety Commission <www.cpsc.gov> will get involved if there are lawsuits or complaints from consumers. Similar organizations in other countries do likewise. There are currently several standards published for portable fuel cell power systems intended to keep them safe:

ANSI/CSA America FC3-2004 American National Standard For Portable Fuel Cell Power Systems

IEC 62282-5-1 International Electrotechnical Commission Portable Fuel Cell Appliance – Safety

IEC/PAS 62282-6-1 (2006-02) International Electrotechnical Commission Micro Fuel Cells - Safety

Following these standards is voluntary, but it is expected that many manufacturers will want to follow them as good practice. In addition to following them as good practice, the International Civil Aviation Organization, ICAO <www.icao.int> has written into their Technical Instructions, Part 8 on Passenger Exceptions, that fuel cell power systems brought on board passenger aircraft as carry-on baggage must conform to IEC PAS 62282-6-1. Since the ICAO Technical Instructions are applied as law in almost every country, this requirement is essentially in force worldwide.

Recent restrictions on carry-on of liquids does affect fuel cells, however, and consultation with security agencies will continue in order to resolve this concern.

How can I learn more?

The most comprehensive up-to-date listing of fuel cell and hydrogen codes and standards can be found at www.fuelcellstandards.com . A bulletin board at that web site provides the opportunity to ask questions of the experts who monitor it.