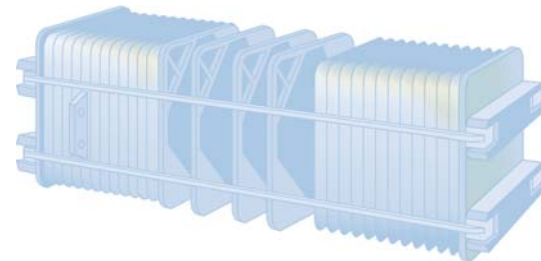




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INTRODUCTION TO THE *REGULATORS' GUIDE TO PERMITTING HYDROGEN TECHNOLOGIES* Family of Documents

hydrogen, fuel cells, and infrastructure





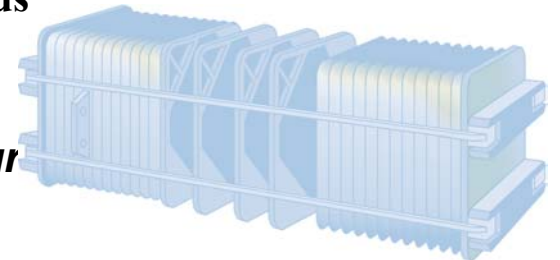
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DOE Hydrogen, Fuel Cells and Infrastructure Technologies Program

OBJECTIVES: Hydrogen Codes and Standards

- (1) Facilitate creation and adoption of model building codes and equipment standards for hydrogen systems for stationary, transportation and portable applications and the infrastructure for the various applications
- (2) Provide technical basis for establishing codes and standards
- (3) Provide technical resources to harmonize the development of international standards
- (4) Familiarize Building Code, Fire Safety and Permitting Officials with the Hydrogen Technologies and Hydrogen-Related Codes and Standards

hydrogen, fuel cells, and infrastructure





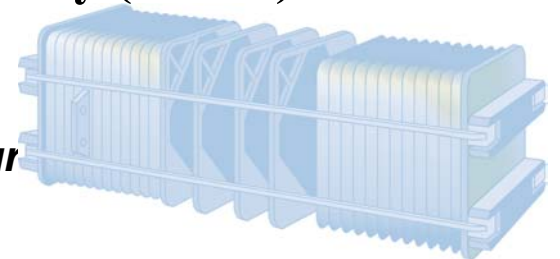
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“REGULATORS GUIDE TO PERMITTING HYDROGEN TECHNOLOGIES” Family of Documents

o Ongoing, Collaborative Department of Energy (DOE) Activity Involving:

- International Code Council (ICC)**
- National Fire Protection Association**
- National Renewable Energy Laboratory (NREL)**
- Pacific Northwest National Laboratory (PNNL)**

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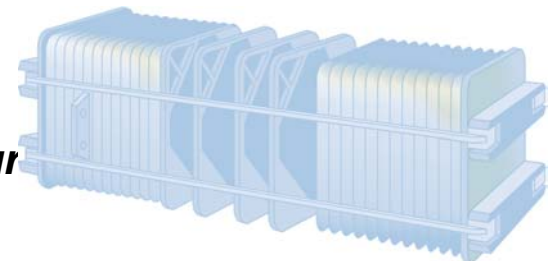
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TARGET AUDIENCES

- o Building Code Officials**
- o Fire Safety Officials**
- o Permitting Officials**

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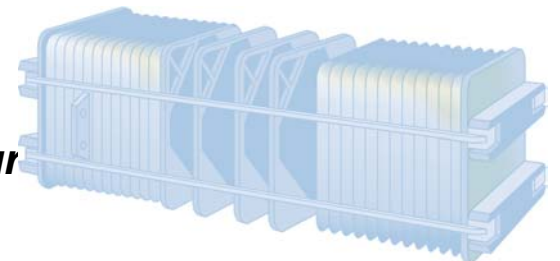
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OBJECTIVES:

- (1) Familiarize Target Audiences with Hydrogen as A Fuel Gas**
- (2) Familiarize Target Audiences with Hydrogen Systems**
- (3) Show Case Studies of Actual Systems**
- (4) For Each Hydrogen Application, Provide a Step-by-Step Guide on the Requirements That the Hydrogen Application Should Meet and the Specific Codes and Standards to Use in the Permitting Process**

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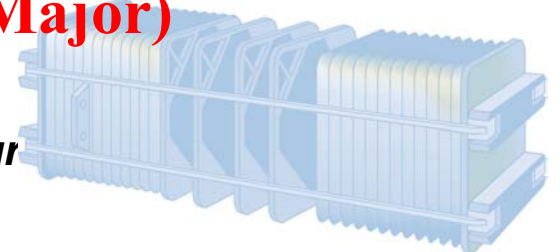
“REGULATORS GUIDE TO PERMITTING HYDROGEN TECHNOLOGIES” Family of Documents

KEY PERSONNEL IN GENERATING THE *GUIDEBOOK*

- o Al Vasys (Consultant to NREL)
- o Bruce Kinzey (PNNL)
- o Carl Rivkin (NFPA)
- o Russ Hewett (NREL)
- o Ruth Taylor (PNNL)

Neil Rossmeissl (DOE/HQ – the Drum Major)

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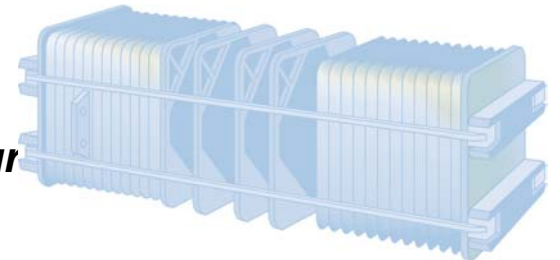
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BACKGROUND

NREL AND NFPA were working collaboratively on two documents to address permitting of hydrogen fueling stations:

- (1) **“Handbook of Representative Hydrogen Fueling Station Projects for Fueling Fuel Cell-Powered Vehicles”**
- (2) **“How to Permit a Hydrogen Fueling station Guidebook for Permitting Officials”**

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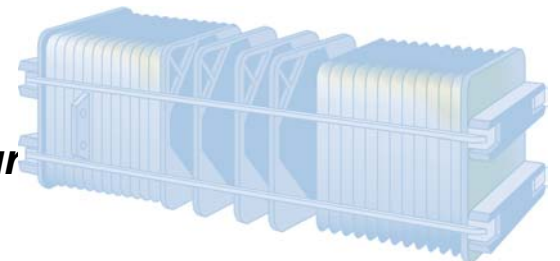
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BACKGROUND

PNNL and ICC were simultaneously -- but independently -- working collaboratively on a document to address permitting of fuel cell projects for buildings:

- o **“Fuel Cell Permitting Guide for Buildings”**

hydrogen, fuel cells, and infrastructure





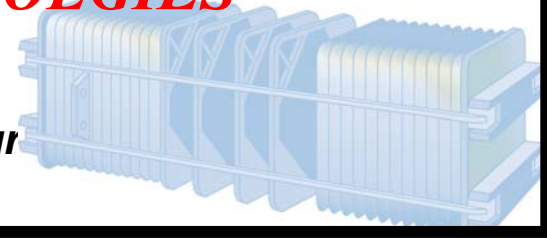
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BACKGROUND

Since the NFPA/NREL and ICC/PNNL Projects Were DOE Activities and Had the Common Objective of Laying Out the Issues and Requirements Associated with Permitting Hydrogen Projects, DOE Initiated A Project (Led by PNNL) to Create A **Harmonized Family of Documents** With A Common Format and the NFPA/NREL and ICC/PNNL Projects Being Integrated into the Family

The Results Are The ***“REGULATORS GUIDE TO PERMITTING HYDROGEN TECHNOLOGIES”***
Family of Documents

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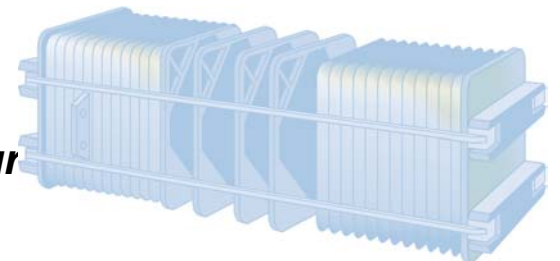
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“REGULATORS GUIDE TO PERMITTING HYDROGEN TECHNOLOGIES” Family of Documents

CURRENTLY, There Are Three Volumes in the Family

- (1) OVERVIEW**
- (2) Module 1: Permitting Stationary Fuel Cell Installations**
- (3) Module 2: Permitting Hydrogen Fueling Stations**

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“REGULATORS GUIDE TO PERMITTING HYDROGEN TECHNOLOGIES” Family of Documents

OVERVIEW

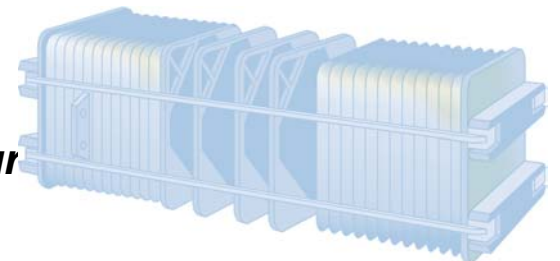
1.0 Brief description and goals of the DOE Hydrogen, Fuel Cells and Infrastructure Technologies Program

2.0 Hydrogen Basics

- o Properties of Hydrogen (Gas and Liquid)
- o How hydrogen compares to other common fuels
- o Primer on hydrogen safety

3.0 Glossary

hydrogen, fuel cells, and infrastructure





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“MODULE 1: PERMITTING STATIONARY FUEL CELL INSTALLATIONS”

1.0 Introduction

2.0 Fuel Cell Basics (All Types)

3.0 Requirements for a Fuel Cell Project for A Building

**4.0 Codes and Standards for Stationary Fuel Cell
Installations**

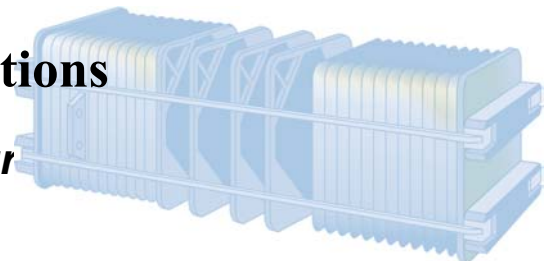
5.0 Case Study

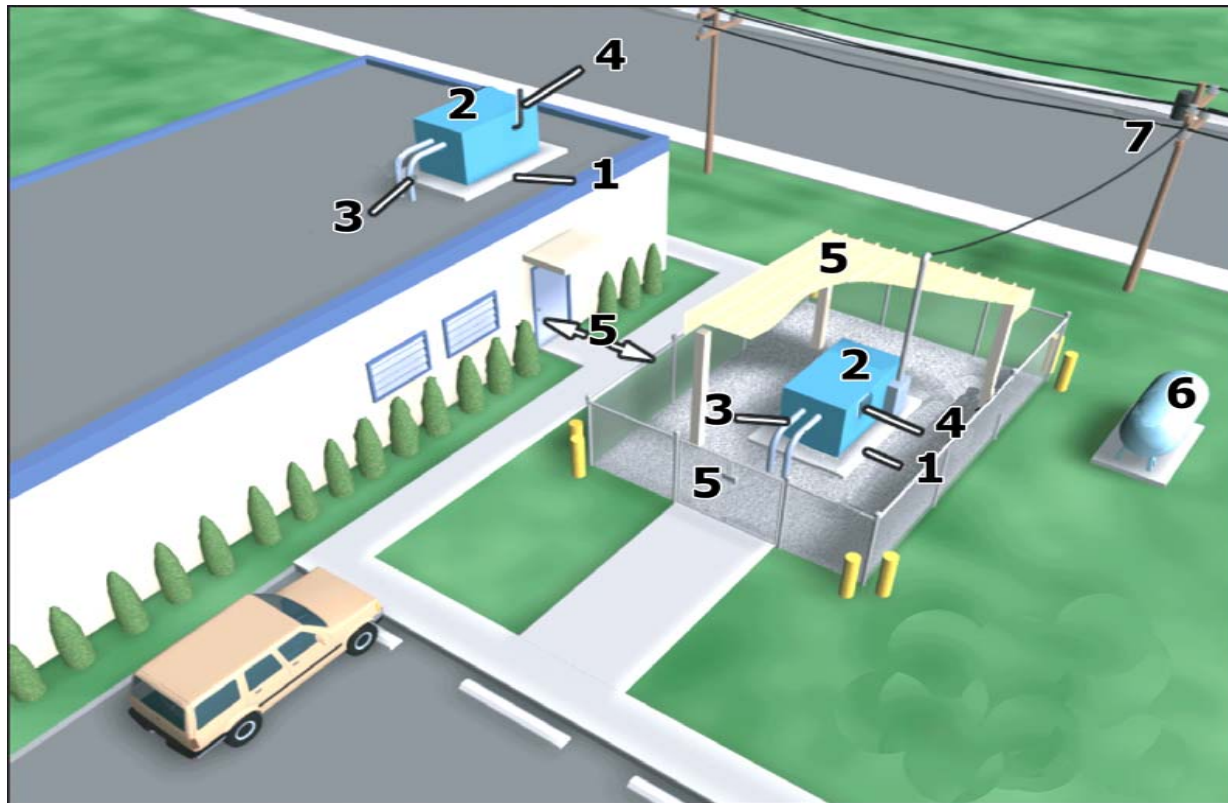
SCOPE of *MODULE 1*

o Liquid and gaseous hydrogen storage

o Fuel Cells: Indoor and outdoor installations

hydrogen, fuel cells, and infrastructure





- 1 Foundation and Protection** (see Table 4.2, section 2.0)
- 2 Fire Protection Systems** (see Table 4.2, section 4.0)
- 3 Piping components and Connections** (see Table 4.2, section 3.0)
- 4 Ventilation, Exhaust and Makeup air** (see Table 4.2, section 2.2)
- 5 Siting, Installation, and Protection** (see Table 4.2, section 2.0)
- 6 Fuel Supply & Storage** (see Table 4.2, section 1.0)
- 7 Interconnections** (see Table 4.2, section 5.0)



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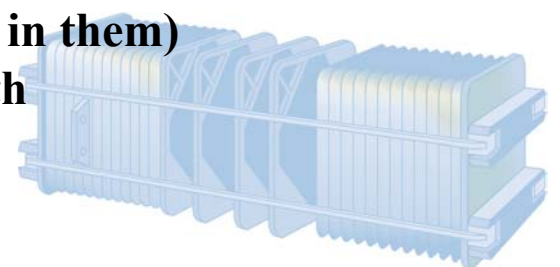
“MODULE 1: PERMITTING STATIONARY FUEL CELL INSTALLATIONS”

4.0 Codes and Standards for Stationary Fuel Cell Installations

4.1 Listing of all Codes and Standards Referenced for Use in permitting fuel cell projects for buildings

4.2 Table/Matrix specifying the permitting process step-by-step

- o Issues and Requirements**
- o What to look for to see that each issue or requirement is met**
- o Codes and standards (and specific references in them) to determine if issue or requirement dealt with**



“MODULE 1: PERMITTING STATIONARY FUEL CELL INSTALLATIONS”

ICC CODES

2000 International Mechanical Code (IMC)

Regulates and controls the design, construction, installation, quality of materials, location, operation and maintenance of use of mechanical systems.

2000 International Fuel Gas Code (IFGC)

Regulates and controls the design, construction, installation, quality of materials, location, operation and maintenance or use of fuel gas systems.

2000 International Fire Code (IFC)

The purpose of the IFC is to establish the minimum requirements consistent with nationally recognized good practice for providing a reasonable level of like safety and property protection from the hazards of fire, explosion or dangerous conditions in new and existing buildings, structures and premises.

2000 International Residential Code (IRC)

Provides minimum requirements to safeguard life or limb, health and public welfare for one and two family occupancies and townhouses.

2000 International Building Code (IBC)

Establishes the minimum requirements to safeguard the public health, safety and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life and property from fire and other hazards attributed to the built environment.

2000 International Plumbing Code (IPC)

Regulates and controls the design, construction, installation, quality of materials, location, operation and maintenance or use of plumbing equipment and systems.

“MODULE 1: PERMITTING STATIONARY FUEL CELL INSTALLATIONS”

NFPA Codes and Standards

NFPA 70 (NFPA 70)

2002 National Electric Code

§692, Fuel Cell Systems—Requirements for the installation of FC power systems, which may be stand-alone or interactive with other electrical power production sources and may be with or without electrical energy storage such as batteries.

NFPA

NFPA 50A / 50B

NFPA 50A – Standard for Gaseous Hydrogen Systems at Consumer Sites

Covers the general principles recommended for the installation of gaseous hydrogen systems on consumer premises where the hydrogen supply to the consumer premises originates outside the consumer premises and is delivered by mobile equipment.

NFPA 50B – Standard for Liquefied Hydrogen Systems at Consumer Sites

Covers the general principles recommended for the installation of liquefied hydrogen systems on consumer premises where the liquid hydrogen supply to the consumer premises originates outside the consumer premises and is delivered by mobile equipment.

NFPA

NFPA 54 - National Fuel Gas Code

Natural Gas Systems

Applies to the installation of fuel gas piping systems, fuel gas utilization equipment, and related accessories.

NFPA

NFPA 58 -Liquefied Petroleum Gas Code

LPG

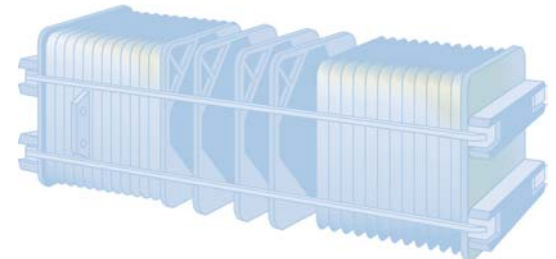
Applies to the highway transportation of LP-Gas and to the design, construction, installation and operation of all LP-Gas systems.

NFPA

NFPA 853-2000 (NFPA 853)

Standard for the Installation of Stationary Fuel Cell Power Plants

NFPA



“MODULE 1: PERMITTING STATIONARY FUEL CELL INSTALLATIONS”

OTHER APPLICABLE CODES AND STANDARDS

AMSE Boiler and Pressure Vessel Code

The International Boiler and Pressure Vessel Code establishes rules of safety governing the design, fabrication, and inspection of boilers and pressure vessels, and nuclear power plant components during construction.

UL 1741 (UL 1741)

Standards for Inverters Converters and Controllers for use in Independent Power Systems, January, 2001

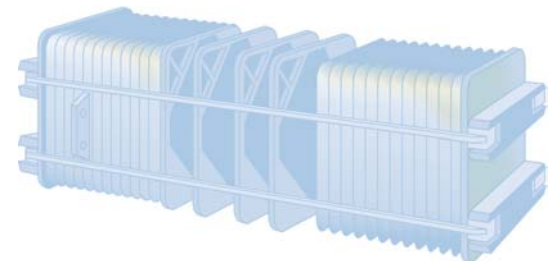
Covers inverters, converters, charge controllers, and output controllers intended for use in stand-alone (not grid-connected) or utility-interactive (grid-connected) power systems. Utility-interactive inverters and converters are intended to be installed in parallel with the electric supply system or an electric utility to supply common loads.

ANSI Z 21.83-1998 (ANSI Z 21.83)

Standards for Installation of Stationary Fuel Cell Power Plants

Provides fire prevention and fire protection requirements for safeguarding life and physical property associated with buildings or facilities that employ stationary fuel cells or all sizes.

CSA



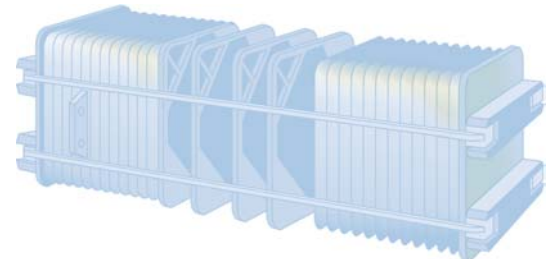
“MODULE 1: PERMITTING STATIONARY FUEL CELL INSTALLATIONS”

ISSUE – The provision title used in the code/standard.

REQUIREMENTS – A brief description of each of the code provisions is provided to give the user an overview of the code text.

WHAT TO LOOK FOR – Guidance is provided to enforcement personnel on what to review for a hydrogen fuel cell installation submittal. The description includes the documentation that should be submitted (e.g., a label or listing) and where the information should be included in the plans or specifications.

CODE/STANDARD – The requisite code or standard that affects the design, installation, equipment specification or operation of the hydrogen fuel cell installation is listed in abbreviated form.



Issue	Requirement Description	What to Look For	Code/Standard
1.0 Fuel Supply and Storage			
1.1 Fuel Supply and Storage-Outside the Fuel Cell			
Natural Gas Fuel Supplies	Covers piping, components and connections from point of delivery to fuel feedstock inlet of the FC	Natural gas in accordance with NFPA 54 or IFGC as applicable. CNG in accordance with NFPA 52 and IFC.	NFPA 853 – §4-2
Liquefied Petroleum Gas (LP-Gas) Systems	Covers piping components and connections from LP-Gas storage or piping system to fuel feedstock inlet of the FC.	LP gas in accordance with NFPA 58 or IFGC as applicable.	NFPA 853-§4-3
Hydrogen Fuel Systems	Covers piping components and connections from gaseous or liquefied storage or piping system to fuel feedstock inlet of the FC.	IBC and NFPA 50A (gaseous) or 50B (liquefied), where the H2 supply to the premises originates off-site, and the H2 is delivered by mobile equipment (i.e., a truck). Requires piping valves and fittings in accordance with ASTM/ANSI B31.3; or IBC and 2003 IFGC for the installation of all gaseous or liquefied hydrogen system	NFPA 853 – §4-4
Biogas Fuel Systems* *Includes landfill gases, anaerobic digester gases and other gases derived from the decomposition of organic materials.	Covers piping components and connections from biogas storage or piping system to fuel feedstock inlet of the FC.	Biogas fuel storage tanks and associated equipment in accordance with NFPA 54 or IFGC as applicable.	NFPA 853-§4-5

Table 4.2. Codes and Standards for Fuel Cell Installations (cont'd)

Issue	Requirement Description	What to Look for	Code/Standard
2.0 General Fuel Cell Siting			
General Siting	Covers the siting and installation of fuel cells and associated equipment for structure stability, protection, proximity to potentially hazardous atmospheres, maintenance, physical damage from impact or vandalism.	<p>Evaluate the requirements of these Sections such that:</p> <ol style="list-style-type: none"> 1. The fuel cell is provided with a firm foundation capable of supporting the equipment or otherwise suspended above exposed surrounding earth. The fuel cell is anchored, located and protected from the elements and from gravity (e.g., dead load, live load, snow, etc.), seismic, hydrodynamic (e.g., flood) and wind loads; lightning and physical damage. The fuel cell is protected against unauthorized access. The FC is located outside of potentially hazardous atmospheres (NFPA 70 and 496). Locations in which fuel cells are installed are considered Class I, Division 2, hazardous locations. The proximity of ignition sources with respect to the power plant shall be located in accordance with the applicable Electric and Fire Codes of reference. In general, this is not an issue for fuel cells having sealed direct vented/ exhausted fuel-carrying compartments or fuel cells designed and installed in accordance with ANSI Z21.83. <p>Sited so as not to affect required exits. Associated exhaust vents/terminations separated from doors, windows, outdoor air intakes or other openings from which exhaust cannot be readily drawn into the building.</p> <p>Access for service and maintenance shall be provided. The FC must be located away from hazardous or combustible materials.</p> <p>Multiple power plants must be sited so that a fire or failure of one plant does not affect the other plant.</p>	NFPA 853 – §3-1 IBC §1609, §1612, §1621, §1805 IFC §304, §305, §312, §2704 IMC §102.3, §303.4, §303.6, §306, §401.5, §501.3

3.0 Fuel Cell Equipment

<p>Stationary Fuel Cell Power Plants Prepackaged, Self-contained Fuel Cell Power Plants Installation and Listing Requirements</p>	<p>General appliance installation provisions for testing and installation of stationary FCs having a power output not exceeding 1,000kW. Allows the use of a fuel cell system to supply electricity to a building. Requires a fuel cell to be evaluated and listed for its intended application.</p>	<p>Confirm that the FC has been tested in accordance with ANSI Z21.83 and installed in accordance with the manufacturer's installation instructions; -OR- where it cannot be demonstrated that the FC has been tested or installed as required (above), the code official must require the submission of any appropriate information and data to assist in the determination of equivalency.</p>	<p>IMC §105, §924 NFPA 853 – §2.1 NFPA 70 – §692.4, §692.6</p>
<p>Stationary Fuel Cell Power Plants Pre-Engineered Fuel Cell Power Plants</p>	<p>General appliance installation provisions for testing and installation of stationary FCs having a power output not exceeding 1,000kW References ANSI Z21.83 for design of pre-engineered fuel cell systems and matched modular components.</p>	<p>Confirm that the fuel cell has been tested “to meet the intent” of ANSI Z21.83 and installed in accordance with the manufacturer's installation instructions; -OR- where it cannot be demonstrated that the fuel cell has been tested or installed as required (above), the code official must require the submission of any appropriate information and data to assist in the determination of equivalency.</p>	<p>IMC §105, §924 NFPA 853 – §2.2</p>

4.0 Fire Protection

Fire Protection & Detection	Provides requirements for siting fire hydrants in addition to general fire detection and alarm systems for fuel cell installations.	For outdoor FCs that do not have flammable or combustible liquid feedstock-fuel storage, confirm that yard or city hydrant protection is provided. A Fire Risk Evaluation is required for all other FC power plants. Confirm that rooms or spaces enclosing fuel cells are provided with an automatic fire detection system.	NFPA 853 – §6-1 IBC §907
Fire-Prevention and Emergency Planning	Requires a written fire prevention and emergency plan based on the size and location of the fuel cell plant	Reporting of emergencies, coordination with emergency response forces, emergency plans, and procedures for managing or responding to emergencies shall comply with the provisions of this Chapter.	NFPA 853 – §6-2 IFC Chapter 4

5.0 Interconnections

Stationary Fuel Cell Power Plants	Requires stationary fuel cells having a power output not exceeding 1,000kW to be installed in accordance with the manufacturers' installation instructions	Verify that the stationary fuel cell is listed. Require the submittal of manufacturers' installation instructions and verify that the installation is in accordance with these instructions.	IMC §924
Interconnections with Other Building Systems	Provides requirements for fuel cell connection with other building systems.	For electrical connections and wiring compliance assessment shall be in accordance with NFPA 70. For fuel gas piping systems and connections compliance assessment shall be in accordance with NFPA 54 or IFGC as applicable	NFPA 853 – §3-5 NFPA 70 – §692 IFGC

“MODULE 2: PERMITTING STATIONARY FUEL CELL INSTALLATIONS”

1.0 Introduction

2.0 Hydrogen Fueling Station Basics

3.0 Hydrogen Storage and Fueling Station Requirements

- o Construction Requirements for Gaseous Hydrogen Storage**
- o Construction Requirements for Liquid Hydrogen Storage**
- o Operating Requirements for Hydrogen Fueling Stations**

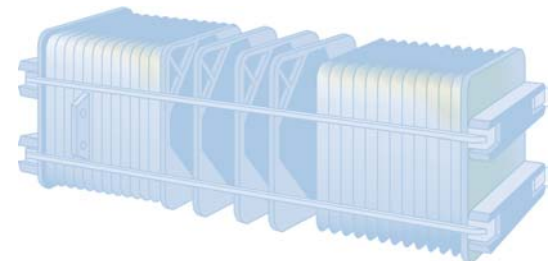
4.0 Codes and Standards for Hydrogen Fueling Stations

- o Overview**
- o Codes and Standards Tables**

5.0 Case Study

SCOPE

- o No underground storage of hydrogen**
- o No On-site generation of hydrogen**
- o No vehicle maintenance operations**



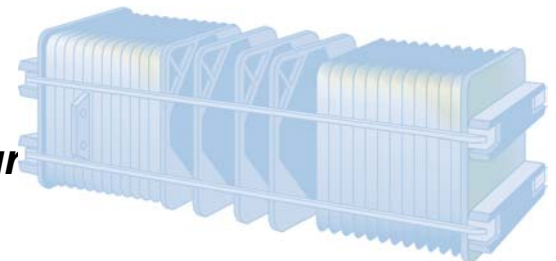
“MODULE 2: PERMITTING STATIONARY FUEL CELL INSTALLATIONS”

3.0 HYDROGEN STORAGE AND FUELING STATION REQUIREMENTS

o OBJECTIVES:

- Reduce the probability of unintended release of hydrogen
- Reduce probability of an accident if there were an unintended release
- o Component and system materials requirements and piping requirements prevent unintended hydrogen releases.
- o System separation distance requirements reduce the probability and severity of accidents.
- o For construction permitting, the requirements are organized so that they follow the chronological order of events involved in construction
- o The requirements for an operating permit are organized to follow the flow of hydrogen through the fueling process (whether as a liquid or gas)

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“MODULE 2: PERMITTING HYDROGEN FUELING STATIONS”

3.0 HYDROGEN STORAGE AND FUELING STATION REQUIREMENTS

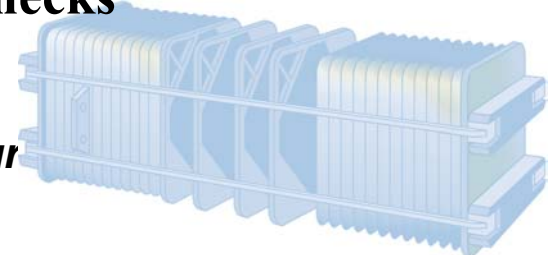
Construction Requirements

- o Site Selection and System Siting**
- o Storage Systems (Liquid and/or Gaseous Hydrogen)**
- o Dispensing System**

Operating Requirements

- o Emergency Response Plan**
- o Written Operating Procedures**
- o Worker Training**
- o Equipment Maintenance**
- o Ongoing Documentation of Safety Checks**
- o Compliance Records**

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“MODULE 2: PERMITTING HYDROGEN FUELING STATIONS”

4.0 Codes and Standards Affecting Design, Installation and Operation of A Hydrogen Storage and Fueling Station

- o Listing of all Codes and Standards Referenced for Use in permitting fueling station projects**

- o Table/Matrix specifying the permitting process step-by-step**
 - Issues and Requirements**
 - What to look for to see that each issue or requirement is met**
 - Codes and standards (and specific references in them) to determine if issue or requirement dealt with**

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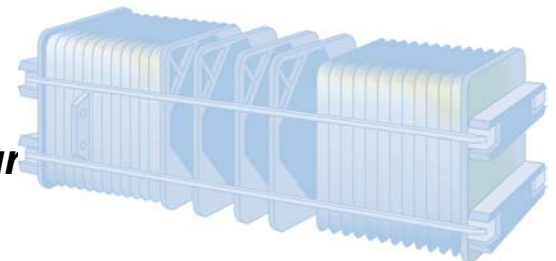


Figure 2.1 shows the basic installation of a stationary hydrogen storage and fueling station that receives and stores liquid hydrogen, vaporizes the hydrogen and compresses it, and then dispenses hydrogen gas into vehicles at 3,600 to 5,000 psi. The basic elements of the installation include liquid hydrogen storage tanks (liquid hydrogen delivered to the site); cryogenic hydrogen compressors for high-pressure hydrogen supply; vaporizers; and gaseous high-pressure storage tanks.

1. The hydrogen must be transported to the fueling station. Although hydrogen could be produced onsite, this module does not deal with onsite production. Fuel cell sites covered by this manual will have the fuel delivered to the site in some manner (truck, train or pipeline).

2. The hydrogen is stored onsite. The hydrogen can be stored as either a gas or liquid on the fueling station site.

3. The hydrogen is converted to its final form. The storage of the hydrogen may be in a different form than required for the final distribution and may be converted onsite. (In the case study, included in this module) the fuel is converted from liquid to gas for final distribution to the vehicles.

4. The hydrogen is distributed to vehicles.

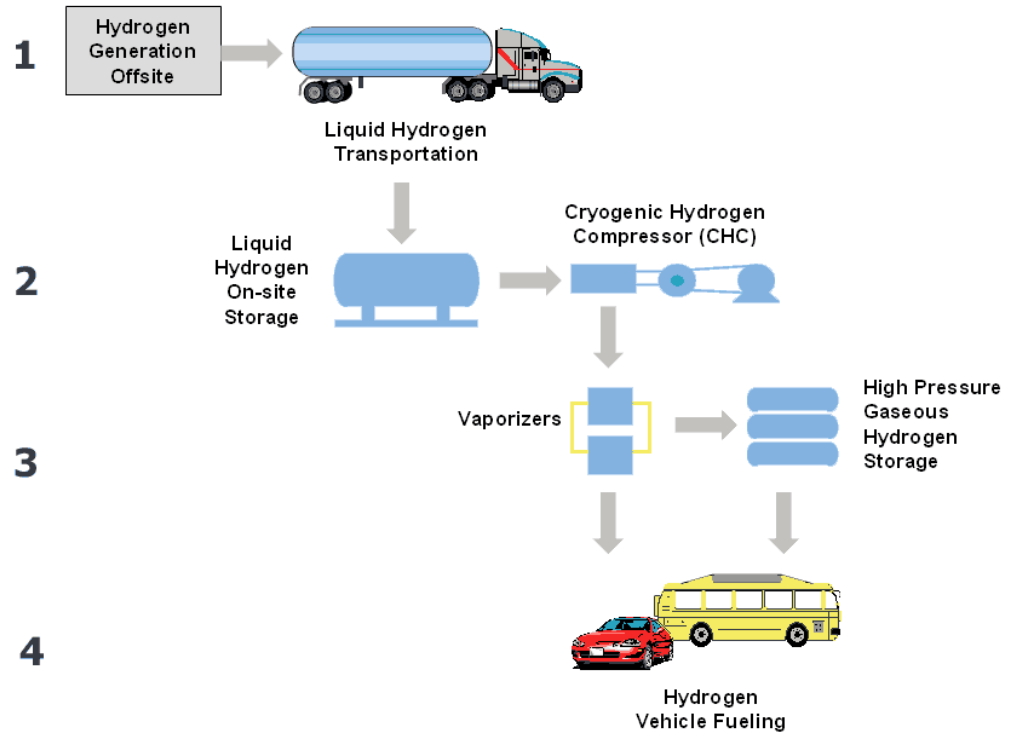


Table 2.1. Properties of Hydrogen and Natural Gas

Property	Natural Gas	Hydrogen
Color	None	None
Specific Gravity (air = 1)	0.424	0.07
Flammability range in air (%)	5.3 to 15	4 to 74
Ignition energy (millijoules)	0.29	0.02
Flame temperature (C°)	2148	2050
Diffusion coefficient (cm ³ /s)	0.15	0.61
Heat value (kJ/kg)	50,020	119,972
Energy density (MJ/nm ³)	35.882	10.783
See Hydrogen Basics section in Overview .		

Table 4.1. Applicable Codes and Standards

Title of Code/Standard	Contact
<p>ASME Boiler and Pressure Vessel Code The Boiler and Pressure Vessel Code establishes rules of safety governing the design, fabrication, and inspection of boilers, pressure vessels, and nuclear power plant components during construction.</p>	ASME
<p>ASME B31.3 (2002) Process Piping Sets forth engineering requirements for the safe design and construction of piping installations typically found in petroleum refineries, chemical, pharmaceutical, textile, paper, semiconductor, cryogenic plants, and related processing plants and terminals*.</p>	ASME
<p>CGA C-7 (2000) Guide to Preparation of Precautionary Labeling and Marking of Compressed Gas Containers Covers use of precautionary labels to warn of principal hazards. Includes general principles and illustrative labels for several types of gases.</p>	CGA
<p>CGA G-5 (2002) Hydrogen Physical Properties Includes the physical properties, how hydrogen is made, used, contained and transported*. CGA G-5 complements G-5.4 and G-5.5 to ensure safe and effective hydrogen installations.</p>	CGA

Table 4.1. Applicable Codes and Standards

Title of Code/Standard	Contact
CGA G-5.4 (2001) Standard for Hydrogen Piping Systems at Consumer Locations Guides engineers, designers and maintenance personnel through materials and components selection to install a safe and effective hydrogen supply system at consumer sites.	CGA
CGA G-5.5 (1996) Hydrogen Vent Systems Presents design guidelines for hydrogen vent systems for gaseous and liquid hydrogen installations at consumer sites, and provides recommendations for their safe operation.	CGA
CGA S-1.1 (1994) Pressure Relief Device Standards-Part 1-Cylinders for Compressed Gases Requirements for pressure relief devices on DOT cylinders for compressed gases. Describes the various types of pressure relief devices, their limitations, design considerations, maintenance, testing and application for various gases.	CGA
CGA S-1.2 (1995) Pressure Relief Device Standards-Part 2-Cargo and Portable Tanks for Compressed Gases Minimum recommended requirements for pressure relief devices for use on cargo tanks (tank trucks) and portable tanks (skid tanks) designed to DOT specifications. Requirements are recommended for application to cargo and portable tanks that do not come within DOT or Canada Transport (TC) jurisdiction. Includes information on application, design, construction, testing and maintenance of pressure relief devices.	CGA
CGA S-1.3 (1995) Pressure Relief Device Standards-Part 3-Stationary Storage Containers for Compressed Gases Minimum recommended requirements for pressure relief devices for* storage containers constructed in accordance with the ASME or API/ASME codes. Includes information on application, design, construction, testing and maintenance for pressure relief devices.	CGA
ANSI/CSA NGV2 (2000) Basic Requirements for Compressed Natural Gas Vehicle (NGV) Fuel Containers Requirements for the material, design, manufacture and testing of serially produced, refillable Type NGV2 containers intended only for the storage of compressed natural gas for vehicle operation. These containers are to be permanently attached to the vehicle. Type NGV2 containers shall not be over 1,000 liters (35.4 cu ft) water capacity.	CSA

Table 4.1. Applicable Codes and Standards

Title of Code/Standard	Contact
<p>2003 International Building Code (IBC) Establishes minimum requirements to safeguard public health, safety and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life* and property from fire and other hazards attributed to the built environment.</p>	ICC
<p>2003 ICC Electrical Code™ (ICC EC) The ICC EC establishes administrative provisions that govern the design and construction of electrical systems and equipment. The electrical design and construction requirements of the International Residential Code or NFPA 70 are referred to as applicable therein.</p>	ICC
<p>2003 International Fire Code (IFC) The IFC establishes minimum requirements consistent with nationally recognized good practice for providing a reasonable level of safety and property protection from the hazards of fire, explosion or dangerous conditions in new and existing buildings, structures and premises.</p>	ICC
<p>2003 International Fuel Gas Code (IFGC) Regulates the design, construction, installation, quality of materials, location, operation and maintenance or use of fuel gas systems.</p>	ICC
<p>2003 International Mechanical Code (IMC) Regulates the design, construction, installation, quality of materials, location operation and maintenance of use of mechanical systems.</p>	ICC
<p>2003 International Residential Code (IRC) Provides minimum requirements for the construction, alteration, movement, replacement, repair and equipment of one and two-family dwellings and townhouses not more than three-stories in height.</p>	ICC
<p>2002 National Electric Code (NFPA 70) Requirements for the inspection, design, review, alteration, modification, construction, maintenance and testing of electrical systems and equipment, including electrical installations at special events.</p>	NFPA

Table 4.1. Applicable Codes and Standards

Title of Code/Standard	Contact
<p>1999 NFPA 50A – Gaseous Hydrogen Systems at Consumer Sites Covers the general principles recommended for the installation of gaseous hydrogen systems on consumer premises where the hydrogen supply to the consumer premises originates outside the consumer premises and is delivered by mobile equipment.</p> <p>1999 NFPA 50B – Liquefied Hydrogen Systems at Consumer Sites Covers the general principles recommended for the installation of liquefied hydrogen systems on consumer premises where the liquid hydrogen supply to the consumer premises originates outside the consumer premises and is delivered by mobile equipment.</p> <p>(NFPA 50A and 50B will be combined in NFPA 55 in the next edition)</p>	NFPA
<p>2002 NFPA 52 – Compressed Natural Gas (CNG) Vehicular Fuel Systems Applies to the design and installation of CNG engine fuel systems on vehicles of all types, including: a) Original equipment manufacturers, b) Vehicle converters, and c) Vehicle fueling (dispensing) systems.</p>	NFPA
<p>2002 NFPA 54 - National Fuel Gas Code Natural Gas Systems Applies to the installation of fuel gas piping systems, fuel gas utilization equipment, and related accessories.</p>	NFPA
<p>2003 NFPA 5000 Building Construction and Safety Code Applies to the construction, protection, and occupancy features necessary to minimize danger to life and property.</p>	NFPA
<p>2003 NFPA 1 Uniform Fire Code The purpose of this Code is to prescribe minimum requirements necessary to establish a reasonable level of fire and life safety and property protection from the hazards created by fire, explosion, and dangerous conditions.</p>	NFPA

Table 4.2. Codes and Standards for Hydrogen Storage and Fueling Facilities (cont'd)

Issue	Requirement Description	What to Look For	Code / Standard
Shutoff valves	A shutoff valve is required for containers and piping to equipment.	Verify the presence and operability of this shutoff device.	IFC – §2209.5.1 IFGC – §704.1.2.5 CGA G-5.4 §4
Electrical equipment and wiring	Fixed electrical equipment and wiring shall be installed in accordance with the applicable electrical code. Classified areas are defined in the applicable table.	Verify that electrical equipment, connections and wiring compliance assessment are in accordance with NFPA 70. Classified areas may be reduced or eliminated as approved and by positive pressure ventilation in accordance with NFPA.	NFPA 50A – §4-1.2, §4-2.5 NFPA 50B – §4-12, T4-12 NFPA 70 – §501 NFPA 496: Standard for Purged and Pressurized Enclosures for Electrical Equipment
Protection from impact	Guard posts or other approved means shall be provided to protect storage tanks and connected piping, valves and fittings; dispensing areas; and use areas subject to vehicular damage. Container valves shall be protected from physical damage.	Confirm the presence and suitability of protection. The design of vehicle barrier systems shall be in accordance with the building code (as applicable). Confirm the presence of protective caps, collars or similar devices for containers.	IFC – §2703.9.3, §2209.5.2, §3003.3, §3003.4, §3203.5, §3503.1.2 IFGC – §707.1 NFPA 50A – § 2-4.3
Security and access by authorized personnel	Areas used for the storage, use and handling of compressed gas containers, cylinders, tanks and systems shall be secured against unauthorized entry and safeguarded in an approved manner.	Evaluate access to equipment, valves, devices, etc., for maintenance. Safeguards shall protect operational controls and mechanisms from unauthorized operation. Inspect the storage site such that it is fenced and posted to prevent entrance by unauthorized personnel.	IFC – §2703.9.2, §3003.3, §3203.5 IFGC – §707.1 NFPA 50A – §2-4.3 NFPA 50B – §3-1.4

Table 4.2. Codes and Standards for Hydrogen Storage and Fueling Facilities (cont'd)

Issue	Requirement Description	What to Look For	Code / Standard
2.0 General Station Siting			
2.1 General			
Installation	The building official is authorized to require construction documents to be prepared by a registered design professional. Personnel familiar with proper installation practices, construction and use of such systems shall supervise installation of liquefied hydrogen systems.	At the time of permit application and at various intervals during the project, detailed technical information shall be submitted to the building official in accordance with state professional registration laws. No one person has the technical knowledge to evaluate all of the various operations, technologies processes, products, materials and uses from a safety standpoint. This section also provides the code official the authority to require the owner to provide a technical opinion safety report. It is critical that the preparer have the proper background and experience for the project since the credibility of the report depends on these qualifications.	CGA G-5 – §7.1, §8 CGA G-5.5 – §6.1 IBC – §106 IFC – §104.7, §105.6.40, §3005.1, §3205.1.1 IFGC– §701 NFPA 50A – §2-4.2 NFPA 50B – §2-4.2 NFPA 5000 - §1.7.6
Adjacent flammable or combustible liquids	Covers circumstances where the fueling station is within a minimum-specified distance (e.g., 50 or 15m) of aboveground storage of all classes of flammable and combustible liquids.	Assess the proximity of adjacent flammable or combustible liquids. Dikes, diversion curbs, grading, or separating solid walls may be used to prevent accumulation of these liquids under the station.	NFPA 50A – §3-1.2

Table 4.2. Codes and Standards for Hydrogen Storage and Fueling Facilities (cont'd)

Issue	Requirement Description	What to Look For	Code / Standard
3.0 Fueling Station Piping & Equipment			
3.1 General			
Insulation	Covers the design of piping systems and equipment to minimize the exposure of piping, surfaces and supports operating at cryogenic temperatures.	Inspect insulation levels and potential personnel exposure points. Insulation shall be noncombustible, vapor-tight and suitable for exposure to the environment.	CGA G-5.4 – §6.2.2, §6.3 CGA G5.5 – §6.11 NFPA 50B – §2-3.4, §3-1.3
Bonding and grounding	<p>equipment, containers and associated piping shall be electrically bonded and grounded. Floor and floor coverings must comply with provisions in CGA.</p> <p>Reference NFPA 70 – §250.90 for general bonding, §250.100 for bonding in hazardous locations and 250.104 (B) for bonding of “other metal piping.” Reference NFPA 70 – §250.116 non-electric equipment (including containers and skid-mounted tanks), NFPA 70 – §250.118 for connection of any supplementary grounding electrode and NFPA 70 – §250.122 for grounding conductor sizing.</p> <p>containers and systems:</p>	<p>Hydrogen equipment, containers and associated piping should be properly bonded in order to prevent static discharges.</p> <p>Verify the size of wire-type grounding conductors such that they penetrate moist soil and are not smaller than Table 250.122. The particular grounding system of choice (metal underground water or gas pipe systems, metal building frame, others) shall be confirmed and evaluated. Other rules apply.</p> <p>All metallic parts (piping, structure supports) within a classified hazardous area shall be at ground potential.</p>	<p>CGA G-5.4 – §6.5 CGA G5.5 – §6.10 NFPA 50B – §2-8 NFPA 70 – §250.90, §250.100, §250.104, §250.116, §250.118, §250.122 IFC – §3003.6, §3203.7, §3503.1.2</p>

Table 4.2. Codes and Standards for Hydrogen Storage and Fueling Facilities (cont'd)

Issue	Requirement Description	What to Look For	Code / Standard
Hoses and hose connections	Covers general requirements for hoses, including materials and selection, testing, protection and support, and limitations on the use of hose connections.	Hose and hose connections shall be listed for hydrogen service. Use of hoses shall be limited to vehicle fueling, inlet connection to compression equipment, and 36-inch (910mm) metallic lengths in piping for flexibility (readily visible and protected from damage).	IFC – §2209.2.2 NFPA 52 – §4-10, §6-9.3
Breakaway devices	Establishes provisions for breakaway protection, their location, installation, arrangement, and separation forces.	Confirm listing and installation of these devices in accordance with the manufacturer's installation instructions such that in the event of a pull-away, hydrogen gas ceases to flow at any separation.	IFC – §2206.7.5, §2206.7.6, §2209.2.2 NFPA 52 – §6-11.7, §6-11.8 SAE 2600: Compressed Hydrogen Vehicle Fueling Connection Devices
Connector depressurization	Transfer systems must be capable of depressurizing to facilitate disconnection. Bleed connections should lead to a safe point of discharge.	Confirm the presence and means for depressurization. Verify location of the point of discharge.	CGA G5 – §8.3 IFC – §2209.2.2 NFPA 52 – §6-14.7



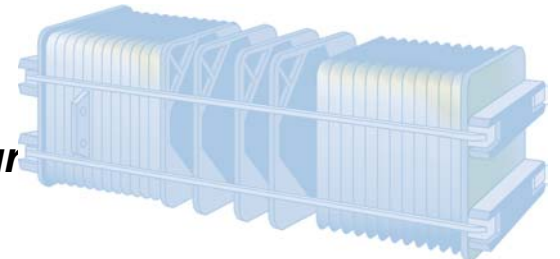
U.S. Department of Energy
Energy Efficiency and Renewable Energy

NEXT STEPS -- With Respect to:

- o ***OVERVIEW***
- o ***Module 1: Permitting Stationary Fuel Cell Installations***
- o ***Module 2: Permitting Hydrogen Fueling Stations***

- (1) Have Documents Reviewed by Sample of Building Code, Fire Safety and Permitting Officials**
- (2) Have Documents Reviewed by DOE Hydrogen Codes and Standards Coordinating Committee and Others**
- (3) Generate Revised Documents Using Results from Reviews**

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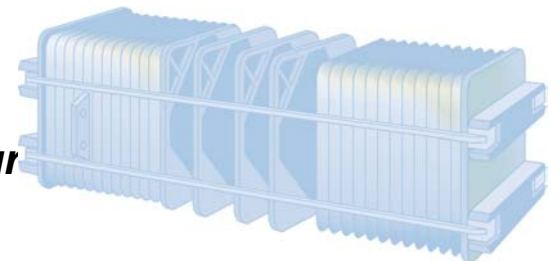
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Energy Efficiency and Renewable Energy

NEXT STEPS:

Generate Additional Modules In The

“REGULATORS’ GUIDE TO PERMITTING HYDROGEN TECHNOLOGIES” Family of Documents

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Energy Efficiency and Renewable Energy

POSSIBILITIES FOR ADDITIONAL MODULES:

- (1) Annual Inspections of Hydrogen Systems**
- (2) Hydrogen Systems Maintenance**
- (3) Permitting Hydrogen Fueling Stations with On-Site Generation of Hydrogen**
- (4) Hydrogen Leak Detection: Systems and Procedures**

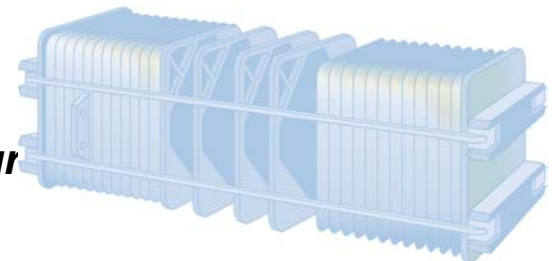
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YOUR SUGGESTIONS?

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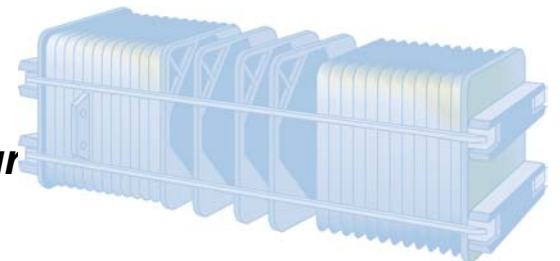


YOUR REACTIONS TO THE

“REGULATORS’ GUIDE TO PERMITTING HYDROGEN TECHNOLOGIES”

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