NFPA® 853

Standard for the Installation of Stationary Fuel Cell Power Systems

2025 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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Text revisions are shaded. A Δ before a section number indicates that words within that section were deleted and a Δ to the left of a table or figure number indicates a revision to an existing table or figure. When a chapter was heavily revised, the entire chapter is marked throughout with the Δ symbol. Where one or more sections were deleted, a • is placed between the remaining sections. Chapters, annexes, sections, figures, and tables that are new are indicated with an *N*.

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NFPA® 853

Standard for the

Installation of Stationary Fuel Cell Power Systems

2025 Edition

This edition of NFPA 853, *Standard for the Installation of Stationary Fuel Cell Power Systems*, was prepared by the Technical Committee on Electric Generating Plants. It was issued by the Standards Council on November 16, 2024, with an effective date of December 6, 2024, and supersedes all previous editions.

This edition of NFPA 853 was approved as an American National Standard on December 6, 2024.

Origin and Development of NFPA 853

In 1997, the Technical Committee on Electric Generating Plants appointed a Task Group on Fuel Cells to begin work on this document. The Standards Council officially approved the project in January 1998. The Council recognized that fuel cells were becoming a popular means of producing electricity and that there were no installation standards for this technology. NFPA 853 addresses fire protection for siting, fuel supplies and storage, ventilation, and general fire protection requirements.

The scope of the 2003 edition was changed significantly from that of the 2000 edition. The 2000 edition did not cover fuel cells smaller than 50 kW; the 2003 edition covered stationary fuel cell power systems of any size.

The changes to the 2007 edition of NFPA 853 were clarifications of existing requirements. The use of the concept of lower flammable limit was changed to correctly distinguish it from lower explosive limit.

The changes to the 2010 edition of NFPA 853 included clarification on the distance that is required between fuel cell power system(s) and stored combustible materials. In addition, several clarifications of existing requirements were made.

The changes to the 2015 edition of NFPA 853 include clarification of ventilation air and its application. Chapter 7 was subdivided into three categories: circulation air, dilution air, and primary air. New definitions were also provided.

The changes to the 2020 edition of NFPA 853 addressed the expanded scope of ANSI/CSA FC 1, *Fuel cell technologies — Part 3-100: Stationary fuel cell power systems — Safety*, both of which now include all pre-engineered and matched modular systems. Sections that allowed alternate compliance options for systems outside the scope of ANSI/CSA FC 1 are no longer needed and were removed.

The changes to the 2025 edition of NFPA 853 include the replacement of the terms *matched* and *factory-matched* with the term *listed* to be more aligned with other NFPA standards, the allowance of listed pre-engineered components of a fuel cell power system to be assembled on site, and the revision of material combustibility definitions so they are in line with their definitions in other NFPA standards. Additional changes include the removal of prescriptive requirements of the fire rated barrier for piping penetrations, fire doors, and fire dampers and revising them to match that of the surrounding barrier.

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Committee Scope: This Committee shall have primary responsibility for documents on fire protection for electric generating plants and high voltage direct current (HVDC) converter stations, except for electric generating plants using nuclear fuel.

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Standard for the

Installation of Stationary Fuel Cell Power Systems

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex C.

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard shall apply to the design, construction, and installation of stationary fuel cell power systems.

1.1.2 The scope of this document shall include the following:

(1) A singular prepackaged, self-contained power system unit
(2) Any combination of prepackaged, self-contained power system units
(3) Power system units comprising two or more listed modular components intended to be assembled in the field
(4) Engineered and field-constructed power systems that employ fuel cells

1.2 Purpose. This document shall provide fire prevention and fire protection requirements for safeguarding life and physical property associated with buildings or facilities that employ stationary fuel cell power systems. This standard shall apply to stationary fuel cells of all sizes.

1.3 Application. This standard shall not apply to portable fuel cells or to fuel cell power systems that are used on any movable structure or vehicle unless the structure or vehicle is made stationary.

1.4 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

1.4.1 Unless otherwise specified, the provisions of this standard shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard. Where specified, the provisions of this standard shall be retroactive.

1.4.2 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.4.3 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

1.5 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.5.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.6 Units and Formulas.

1.6.1 The units of measure in this standard are presented in the International System (SI) of Units. Where presented, US customary (inch-pound) units follow the SI units in parentheses.

1.6.2 Where both systems of units are presented, either system shall be acceptable for satisfying the requirements of this standard.

1.6.3 Where both systems of units are presented, users of this standard shall apply one set of units consistently and shall not alternate between units.

1.6.4 The values presented for measurements in this standard are expressed with a degree of precision appropriate for practical application or enforcement. It is not intended that the application or enforcement of these values be more precise than the precision expressed.

1.6.5 Where extracted text contains values expressed in only one system of units, the values in the extracted text have been retained without conversion to preserve the values established by the responsible technical committee in the source document.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 2, *Hydrogen Technologies Code,* 2023 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection,* 2022 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances,* 2025 edition.

NFPA 30, *Flammable and Combustible Liquids Code,* 2024 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment,* 2024 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work,* 2024 edition.

NFPA 52, *Vehicular Natural Gas Fuel Systems Code,* 2023 edition.

NFPA 54, *National Fuel Gas Code,* 2024 edition.

NFPA 55, *Compressed Gases and Cryogenic Fluids Code,* 2023 edition.

NFPA 58, *Liquefied Petroleum Gas Code,* 2024 edition.

NFPA 70®, National Electrical Code®, 2023 edition.

NFPA 72®, National Fire Alarm and Signaling Code®, 2025 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives,* 2025 edition.

NFPA 101®, *Life Safety Code®,* 2024 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations,* 2022 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials,* 2023 edition.

2.3 Other Publications.

2.3.1 ASME Publications. The American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

ANSI/ASME A13.1, *Scheme for the Identification of Piping Systems*, 2023.

ANSI/ASME B31.3, *Process Piping*, 2022.

2.3.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2023d.

ASTM E108, *Standard Test Methods for Fire Tests of Roof Coverings*, 2020a.

ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, 2023.

ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*, 2022.

ASTM E2652, *Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C*, 2022.

ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, 2022a.

2.3.3 CSA Group Publications. CSA Group, 178 Rexdale Boulevard, Toronto, ON M9W 1R3, Canada.

ANSI/CSA FC 1, *Fuel cell technologies — Part 3-100: Stationary fuel cell power systems — Safety*, 2021.

Δ **2.3.4 UL Publications.** Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 263, *Fire Tests of Building Construction and Materials*, 2011, revised 2022.

UL 723, *Test for Surface Burning Characteristics of Building Materials*, 2018, revised 2023.

UL 790, *Test Methods for Fire Tests of Roof Coverings*, 2022.

2.3.5 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2020.

Δ **2.4 References for Extracts in Mandatory Sections.**

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems,* 2024 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids,* 2020 edition.

NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials,* 2025 edition.

NFPA 5000®, Building Construction and Safety Code®, 2024 edition.

Chapter 3 Definitions

Δ **3.1 General.**

N **3.1.1** The definitions contained in this chapter shall apply to the terms used in this standard.

N **3.1.2** Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used.

N **3.1.3** *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3 General Definitions.

3.3.1 Air.

3.3.1.1 ***Circulation Air.*** The portion of supply air, the source of which is the outside/outdoors, plus any recirculated air that has been treated and is acceptable for use by the power system ventilation system that is used to cool equipment located in areas unclassified per Articles 500–516 of *NFPA 70*.

3.3.1.2 ***Dilution Air.*** The portion of supply air, the source of which is the outside/outdoors, plus any recirculated air that has been treated and is acceptable for use by the power system ventilation system that is used to cool equipment or dilute normal and abnormal releases to below a flammable level located in areas classified per Articles 500-516 of *NFPA 70*.

3.3.1.3 ***Exhaust Air.*** Air removed from a space or power system and not reused.

3.3.1.4 ***Primary Air.*** The portion of supply air, the source of which is the outside/outdoors, plus any recirculated air that has been treated and is acceptable for use by the power system for the purpose of conversion of fuel and air to power and heat.

3.3.1.5 ***Ventilation Air.*** The portion of supply air, the source of which is the outside/outdoors, plus any recirculated air that has been treated and is acceptable for use by the power system ventilation system that can be used for circulation, dilution, and/or primary air applications.

3.3.2 Booster. An electrically driven, sealed gas, in-line, pressure-boosting device that supplies fuel that is consumed by a continuous process without intermediate storage.

3.3.3 Combustible. Capable of undergoing combustion.

3.3.4 Compressor. A device used for increasing the pressure and density of a gas.

3.3.5* Distributed Integrated Controls (DIC). Systems or integrated controls used to monitor and control the functions of equipment, systems, or plants.

3.3.6 Evaluation.

3.3.6.1 ***Base Flood Evaluation.*** A reference point based on the depth or peak elevation of flooding, including wave height, which has a 1 percent (100 year) or greater chance of occurring in any given year.

3.3.6.2* ***Fire Risk Evaluation.*** A detailed engineering review of a plant's construction features and operating process conducted to ensure that applicable fire prevention and fire protection requirements for safeguarding life and physical property are met.

Δ **3.3.7 Fire Damper.** A listed device installed in an air distribution system and designed to close automatically upon detection of heat, to interrupt migratory airflow, and to restrict the passage of flame. [**90A,** 2024]

3.3.8 Fire Prevention. Measures directed toward avoiding the inception of fire. [**801,** 2025]

3.3.9 Fire Protection. Methods of providing for fire control or fire extinguishment. [**801,** 2025]

3.3.10 Flammable Liquid. A liquid that has a closed-cup flash point that is below 37.8°C (100°F) and a maximum absolute vapor pressure of 2068 mm Hg (40 psi) at 37.8°C (100°F).

3.3.11 Flash Point. The minimum temperature at which a liquid or a solid emits vapor sufficient to form an ignitable mixture with air near the surface of the liquid or the solid.

3.3.12* Fuel Cell Power System. A generator system that converts the chemical energy of reactants (a fuel and oxidant), via an electrochemical process, to electric energy (direct current or alternating current electricity) and thermal energy.

3.3.12.1* ***Engineered and Field-Constructed Fuel Cell Power System.*** A fuel cell power system that is not preassembled or does not have a listed design.

Δ **3.3.12.2** ***Pre-Engineered and Listed Modular Components Fuel Cell Power System.*** A fuel cell power system, such as a fuel cell stack, reformer, or inverter, with a listed design that is assembled on-site in separate modules.

3.3.12.3 ***Prepackaged, Self-Contained Fuel Cell Power System.*** A fuel cell power system that is designed as one unit, assembled in a factory, and shipped to a site.

3.3.13 Gas.

3.3.13.1* ***Digester Gas.*** The biogas derived by fermentation of organic wastes, such as sewage, animal and food waste, and industrial organic waste.

3.3.13.2* ***Landfill Gas.*** The biogas derived from decomposition of municipal solid waste (landfill).

3.3.14 Hazardous Material (Chemical). A substance that, by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, or otherwise harmful, is likely to cause death or injury.

3.3.15 Installation. The location where a fuel cell power system is sited as a unit or built as an assembly.

3.3.15.1* ***Indoor Installation.*** A fuel cell power system completely surrounded and enclosed by walls, a roof, and a floor.

3.3.15.2 ***Outside or Outdoor Installation.*** A power system installation that is not located inside a building or that has only partial weather protection (maximum coverage of a roof and up to 50 percent enclosing walls).

3.3.15.3 ***Portable Fuel Cell Installation.*** A fuel cell generator of electricity that is not fixed in place. A portable appliance utilizes a cord and plug connection to a grid-isolated load and has an integral fuel supply.

3.3.15.4 ***Rooftop Installation.*** A power system installation located on the roof of a building.

Δ **3.3.16 Limited Combustible.** See 4.5.2.

3.3.17 Listing Agency. An organization acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials and whose listing states that the equipment or material either meets appropriate standards or has been tested and found suitable for use in a specified manner.

3.3.18 Lower Flammable Limit (LFL). The lowest concentration of a flammable gas/vapor in air in which flame is propagated.

Δ **3.3.19 Noncombustible.** See 4.5.1.

3.3.20 Stationary. Permanently connected and fixed in place.

3.3.21 System.

3.3.21.1 ***Automatic Fire Detection System.*** A fire detection system that senses the presence of fire, smoke, or heat and activates a sprinkler system or an automatic alarm system.

3.3.21.2 ***Automatic Sprinkler System.*** A sprinkler system of pipes with water under pressure that allows water to be discharged immediately when a sprinkler head operates.

3.3.21.3 ***Biogas Fuel Cell System.*** A fuel cell system comprised of a conventional biogas source, such as a landfill gas site or municipal sewage digester site, a fuel cell specific gas cleanup unit, and a prepackaged or listed modular fuel cell power system.

3.3.21.4 ***Direct-Vented System.*** A venting system by which all air for combustion is obtained from the outside atmosphere, and all exhaust air/gases are discharged to the outside atmosphere.

3.3.21.5 ***Duct System.*** A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, fans, and accessory air-managing equipment and appliances.

3.3.21.6 ***Exhaust System.*** An air-conveying system for moving materials from a source to a point of discharge. [**91,** 2020]

3.3.22 Ventilation.

3.3.22.1 ***Mechanical Ventilation.*** The flow of air or gas created by a fan, blower, or other mechanical means that will push or induce the gas stream through a ventilation system.

3.3.22.2 ***Natural Ventilation.*** The flow of air or gases created by the difference in the pressures or gas densities between the outside and inside of a vent, room, or space.

Chapter 4 General Equipment Configuration

4.1* General.

4.2 Prepackaged, Self-Contained Fuel Cell Power Systems. Prepackaged, self-contained fuel cell power systems shall be designed, tested, and listed in accordance with ANSI/CSA FC 1, *Fuel cell technologies — Part 3-100: Stationary fuel cell power systems — Safety.*

4.3 Pre-Engineered and Listed Modular Fuel Cell Power Systems. Pre-engineered fuel cell power systems and listed modular components (which are assembled on site) shall be designed, tested, and listed in accordance with ANSI/CSA FC 1, *Fuel cell technologies — Part 3-100: Stationary fuel cell power systems — Safety.*

4.4 Engineered and Field-Constructed Fuel Cell Power Systems.

4.4.1 Documentation for engineered and field-constructed fuel cell power systems shall be provided.

4.4.2 Documentation shall include a fire risk evaluation prepared by a registered engineer or third party acceptable to the authority having jurisdiction.

N **4.5 Material Combustibility.**

N **4.5.1* Noncombustible Material.**

N **4.5.1.1** A material that complies with any one of the following shall be considered a noncombustible material:

(1)* The material, in the form in which it is used, and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.
(2) The material is reported as passing ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C.*
(3) The material is reported as complying with the pass/fail criteria of ASTM E136 when tested in accordance with the test method and procedure in ASTM E2652, *Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C.*

[**5000:**7.1.4.1.1]

N **4.5.1.2** Where the term *limited-combustible* is used in this standard, it shall also include the term *noncombustible.* [**5000:**7.1.4.1.2]

N **4.5.2* Limited-Combustible Material.** A material shall be considered a limited-combustible material where one of the following is met:

(1) The conditions of 4.5.2.1 and 4.5.2.2, and the conditions of either 4.5.2.3 or 4.5.2.4, shall be met.
(2) The conditions of 4.5.2.5 shall be met.

[**5000:**7.1.4.2]

N **4.5.2.1** The material does not comply with the requirements for a noncombustible material in accordance with 4.5.1. [**5000:**7.1.4.2.1]

N **4.5.2.2** The material, in the form in which it is used, exhibits a potential heat value not exceeding 8141 kJ/kg (3500 Btu/lb) when tested in accordance with NFPA 259. [**5000:**7.1.4.2.2]

N **4.5.2.3** The material shall have a structural base of noncombustible material with a surfacing not exceeding a thickness of 3.2 mm (⅛ in.) where the surfacing exhibits a flame spread index not greater than 50 when tested in accordance with ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or UL 723, *Test for Surface Burning Characteristics of Building Materials*. [**5000:**7.1.4.2.3]

N **4.5.2.4** The material shall be composed of materials that in the form and thickness used neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723 and are of such composition that all surfaces that would be exposed by cutting through the material on any plane would neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723. [**5000:**7.1.4.2.4]

N **4.5.2.5** Materials shall be considered limited-combustible materials where tested in accordance with ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, at an incident heat flux of 75 kW/m^2 for a 20-minute exposure, and both the following conditions are met:

(1) The peak heat release rate shall not exceed 150 kW/m^2 for longer than 10 seconds
(2) The total heat released shall not exceed 8 MJ/m^2

[**5000:**7.1.4.2.5]

N **4.5.2.6** Where the term *limited-combustible* is used in this standard, it shall also include the term *noncombustible*. [**5000:**7.1.4.2.6]

Chapter 5 Siting and Interconnections

5.1 General Siting.

5.1.1 A fuel cell power system(s) and associated equipment, components, and controls shall be sited and installed in accordance with the manufacturer's instructions and meet the following requirements:

(1) It shall be placed on a firm foundation that is capable of supporting the equipment or components.
(2) It shall be anchored, located, and protected so that the system and equipment will not be adversely affected by rain, snow, ice, freezing temperatures, wind, seismic events, and lightning.
(3) It shall be located so the foundation of, and access to, associated components and the fuel cell power system are above the base flood elevation.
(4) It shall be protected against access by unauthorized persons commensurate with the location and installation environment. Fire department access shall be provided.
(5)* It shall be located outside potentially hazardous atmospheres as defined by Article 500 or Article 505 of *NFPA 70*, unless listed and approved for the specific installation.
(6) It shall be sited so the power system and equipment do not affect required building exits during normal operations or fire emergencies.
(7) It shall be located so the power system(s) and components of a listed modular or field-engineered fuel cell power system and their respective vent or exhaust terminations are separated from doors, windows, outdoor air intakes, and other openings into a building.
(8) It shall be located in a manner that allows service, maintenance, and emergency access.
(9) It shall be located 1.5 m (5 ft) away from stored combustible materials, hazardous chemicals, high-piled stock, and other exposures to fire hazards.
(10)* It shall be located or protected to prevent physical damage.
(11) It shall be located such that a fire or failure of one of the systems does not present an exposure hazard to adjacent fuel cell power systems.
(12) Fuel cell power systems and, if provided, their weatherproof enclosures shall be located to maintain manufacturer-specified clearances to structures having combustible walls in accordance with the product listing and the manufacturer's instructions.

5.1.2* Where demonstrated by an engineering analysis that the prescriptive requirements in this section are unnecessary to achieve an equivalent level of safety, approved alternatives shall be permitted.

5.1.3 Fire protection for systems and areas under construction shall comply with NFPA 241.

5.2 Outdoor Installations.

5.2.1 For outdoor installations, a fuel cell power system and related components shall be designed and constructed for outdoor installation.

5.2.2 Air intakes to a fuel cell power system shall be located so the system is not adversely affected by other exhausts, gases, or contaminants.

5.2.3 The exhaust outlet(s) from process areas or areas that contain fuel-bearing components of a fuel cell power system shall be located at least 4.6 m (15 ft) from heating, ventilating, and air-conditioning (HVAC) air intakes, windows, doors, and other openings into buildings.

5.2.3.1 The exhaust outlet(s) shall not be directed onto walkways or other paths of travel for pedestrians.

5.2.3.2 The area classification around outlets from processes or compartments that contain fuel-bearing components shall be in accordance with Article 500 or Article 505 of *NFPA 70*.

5.2.4 Security barriers, fences, landscaping, and other enclosures shall not affect the required air flow into or exhaust out of the fuel cell power system and its components.

5.2.5 Fuel cell power systems shall not be located in areas that are used or are likely to be used for combustible, flammable, or hazardous materials storage.

5.3 Indoor Installations. A fuel cell power system and its associated components that are not located in areas designed for industrial uses shall be located in a room that meets the conditions of 5.3.1 through 5.3.6.

Δ **5.3.1** The room shall be separated from the remainder of the building by fire barrier walls and horizontal assemblies with a minimum of a 1-hour fire resistance rating in accordance with ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, or UL 263, *Fire Tests of Building Construction and Materials*.

Δ **5.3.2** Piping penetrations and joints that travel through a fire-rated barrier wall or horizontal assembly associated with the room shall be sealed with listed or approved materials that have a fire resistance rating equal to that found using 5.3.1.

5.3.3 Openings between the room and other occupied spaces shall be protected by fire doors and dampers.

Δ **5.3.4** Fire doors shall be installed in accordance with NFPA 80 and have a fire protection rating equal to that of the barrier.

5.3.5 Fire dampers shall be installed in accordance with NFPA 80 and have a fire protection rating equal to that of the barrier.

5.3.6 Each room shall be provided with egress in accordance with NFPA 101 or the locally adopted building code.

5.4 Rooftop Installation.

5.4.1 Fuel cell power systems and components located on rooftops shall be installed in accordance with Section 5.2.

Δ **5.4.2** The roofing material under and within 30.5 cm (12 in.) horizontally from a fuel cell power system or component shall be noncombustible or shall have a Class A rating when tested in accordance with ASTM E108, *Standard Test Methods for Fire Tests of Roof Coverings*, or UL 790, *Test Methods for Fire Tests of Roof Coverings*.

5.5 Interconnections with Other Building Systems.

5.5.1 All electrical connections and wiring to the power system(s) or components of listed modular or field-engineered fuel cell power systems shall be in accordance with *NFPA 70*.

5.5.1.1 The installation requirements of fuel cell power systems shall be in accordance with Article 692 of *NFPA 70*.

5.5.2 Fuel gas connections to the power system(s) or components of a listed modular or field-engineered fuel cell power system shall be in accordance with Chapter 6.

5.5.3 The location of the manual fuel shutoff valve required by Chapter 6 shall be marked at the location of the primary disconnecting means of the building or supplied circuits.

Chapter 6 Fuel Supplies and Storage Arrangements

6.1 General.

6.1.1 The installation and location of fuel cell power system fuel supplies, associated fuel piping, and components and their connection to a stationary fuel cell power system shall be in accordance with this chapter.

6.1.2 All gaseous fuel piping outside the fuel cell power system shall be marked or identified in accordance with ANSI/ASME A13.1, *Scheme for the Identification of Piping Systems*.

6.2 Natural Gas Fuel Supplies.

6.2.1 Natural Gas.

6.2.1.1 Piping, valves, and fittings from the outlet of the supplier's piping to the outlet of the fuel cell power system's shutoff valve shall be in accordance with NFPA 54.

6.2.1.2* Where deodorized gas is stored, piping shall be configured to prohibit reverse flow of natural gas into other buildings or source piping.

6.2.2 Compressed Natural Gas (CNG). The design, location, and installation of piping, valves, and fittings from the outlet of the point of delivery from the supplier to the inlets of the equipment shutoff valves shall be in accordance with NFPA 52.

6.3 Liquefied Petroleum Gas (LP-Gas) Systems and Storage.

6.3.1 The design, location, and installation of liquefied petroleum gas (LP-Gas) storage and piping systems shall comply with NFPA 58.

6.3.2 In the determination of separation distances from the fuel cell power system to LP-Gas containers required by NFPA 58, the power system shall be considered a building.

6.4* Hydrogen Fuel Systems and Storage.

6.4.1 Gaseous Hydrogen Storage. The design, location, and installation of gaseous hydrogen storage shall comply with NFPA 2.

6.4.2 Liquid Hydrogen Storage. The design, location, and installation of liquid hydrogen storage shall comply with NFPA 2.

6.4.3 Hydrogen Piping. Hydrogen piping, valves, and fittings from the hydrogen storage system to the fuel cell power system shall conform to ANSI/ASME B31.3, *Process Piping*, and 6.4.3.1 through 6.4.3.7.

6.4.3.1* An accessible manual shutoff valve shall be located in the hydrogen piping to the fuel cell power system within 1.8 m (6 ft) of the storage container.

6.4.3.2* The hydrogen supply piping to the fuel cell power system shall be provided with a second accessible manual shutoff valve that is located within 1.8 m (6 ft) of the power system, unless the power system is enclosed by a room with a 1-hour fire resistance rating as described in Section 5.3. If the hydrogen storage is within 1.8 m (6 ft) of the fuel cell power system, the valve described in 6.4.3.1 shall be considered to meet this requirement.

6.4.3.3 If the power system is enclosed by a room with a 1-hour fire resistance rating, the valve shall be located outside the room.

6.4.3.4 For indoor installation of a power system, where the fuel supply is stored outdoors, an automatic shutoff valve interlocked with gas detection shall be located outside the building that houses the power system in accordance with 8.1.5.

6.4.3.5 Piping, valves, regulators, or other equipment shall be located so that they are not subject to physical damage or otherwise be protected against physical damage.

6.4.3.6 Areas classified as Class I, Division 2 due to hydrogen piping shall be provided with ventilation to the outdoors.

6.4.3.7 Hydrogen containers and associated piping shall be electrically grounded and bonded in accordance with *NFPA 70*.

6.5* Biogas Fuel Systems.

6.5.1 Biogas fuel systems, including landfill gases, anaerobic digester gases, and other gases derived from the decomposition of organic materials, shall be permitted to be used as a fuel supply for a fuel cell power system.

6.5.2 Additional fuel gas cleanup equipment shall be considered part of the associated equipment.

6.5.3 Biogas fuel system storage tanks and their associated equipment, piping, valves, and regulators shall be designed and installed in accordance with NFPA 54.

6.6* Liquid Fuels. The design of liquid fuel piping systems and the location and storage of liquid fuels shall be in accordance with NFPA 30.

6.7 Solid Fuels. Solid fuels acceptable to the authority having jurisdiction shall be permitted to be used as fuel for fuel cell power systems.

Chapter 7 Ventilation and Exhaust

7.1 General.

7.1.1 All fuel cell power systems shall be provided with a source of air in accordance with this chapter, with the exception of the following:

(1) Fuel cell power systems installed outdoors
(2) Listed prepackaged or pre-engineered and listed modular fuel cell power systems that have a sealed, direct ventilation and exhaust system that is installed in accordance with the terms of the listing and manufacturer's installation instructions

7.1.2* The ventilation and exhaust system shall be designed to provide a negative or neutral pressure in the room, with respect to the building.

7.1.3 The ventilation air and exhaust air system(s) shall meet the requirements specified in Sections 5.1, 7.2, and 7.3.

7.1.4 If mechanical ventilation is required, a control interlock shall be provided to shut down the unit upon loss of ventilation.

7.2 Ventilation Air.

7.2.1* A separate mechanical building ventilation system shall be provided for the area where a fuel cell power system is located.

7.2.2 If it can be verified, natural ventilation shall be permitted to provide all required ventilation air.

7.2.3 The inlets for all primary, ventilation, and exhaust air system(s) shall be designed to prevent foreign matter from entering and/or accumulating.

7.3 Exhaust Systems.

7.3.1 An exhaust system shall be provided for the area where a fuel cell power system is located.

7.3.2 The fuel cell power system exhaust system shall be designed so that all harmful emissions are exhausted to a safe location.

7.3.3 The building ventilation exhaust rate from the room shall not be less than 0.3 $m^3/min \cdot m^2$ (1 cfm/ft^2) of floor area and not less than 4.25 m^3/min (150 cfm).

7.3.4 If mechanical exhaust for either the fuel cell power system or the building is required, a control interlock shall be provided to shut down the fuel cell power system upon loss of either exhaust.

7.3.5 The exhaust outlet(s) shall be located as specified in 5.2.3.

7.3.6 The discharge for exhaust from the fuel cell power system and building air system(s) shall be designed to prevent foreign matter from entering and accumulating.

7.4 Process Purging and Venting.

7.4.1 Pressure tanks and piping intended to be purged, pressure regulators, relief valves, and other potential sources of combustible gas shall be vented to the outside of the building, terminating at least 4.6 m (15 ft) from air intakes, windows, doors, or other building openings.

7.4.2 The vent shall be designed to prevent entry of water or foreign objects.

Chapter 8 Fire Protection

8.1 Fire Protection and Detection.

8.1.1 Site Fire Protection.

8.1.1.1 Sites that have flammable or combustible liquid fuel storage shall have fire hydrants provided in accordance with NFPA 30 and NFPA 24.

8.1.1.2 The hydrants specified in 8.1.1.1 shall have a water supply of at least 946 L/min (250 gpm) for 2 hours.

8.1.1.3 Fuel cell power systems that do not have flammable or combustible liquid fuel storage and are located outside buildings that have yard or city hydrant protection shall be considered to have required site protection.

8.1.1.4 If fuel cell power systems are sited at locations that do not have hydrant protection, power systems shall be protected in accordance with a fire risk evaluation.

8.1.1.5 Fuel cell power systems located inside buildings shall be protected in accordance with 8.1.5.

8.1.2* Fuel Cell Fire Protection and Detection. Fuel cell systems designed and constructed in accordance with Section 4.4 shall be provided with an automatic fire detection and alarm system in accordance with *NFPA 72*.

8.1.3 Electrical Equipment and Components.

8.1.3.1 Transformers installed in compartments, in modules, or in rooms that contain fuel cell power systems shall be the dry type.

8.1.3.2 All transformers shall be installed in accordance with *NFPA 70*.

8.1.3.3 Oil-filled transformers that have at least 1892 L (500 gal) capacity shall be protected by one of the following:

(1) A minimum spatial separation of 7.6 m (25 ft) between each transformer containment area and other structures
(2) A 2-hour-rated fire barrier between adjacent noncombustible or limited combustible structures, transformers, or switchgear that extend 30.5 cm (1 ft) above the transformer or structure and 61 cm (2 ft) beyond the sides
(3) An automatic deluge water spray system designed in accordance with NFPA 15 to provide a minimum density of 10.2 L/min·m^2 (0.25 gpm/ft^2) over all surfaces of the transformer

8.1.3.4 Transformers filled with a listed less flammable liquid that also bear a certification from a listing agency shall be permitted to be installed at least 1.5 m (5 ft) from noncombustible walls and 3.0 m (10 ft) from doors, fire escapes, and windows, provided installation is also in accordance with the listing agency requirements.

8.1.4 Control Rooms and Distributed Integrated Controls Equipment. If a separate room or building is provided for a fuel cell power system's monitoring and control, the room or building shall be constructed in accordance with the appropriate building code and shall comply with NFPA 101.

8.1.5 Indoor Installation.

8.1.5.1 Indoor liquid fuel pumps shall be protected by an automatic fire suppression system.

8.1.5.2* Liquid fuel systems shall be provided with curbing, diking, or drainage in accordance with NFPA 30.

8.1.5.3 When an automatic fire suppression system is provided, it shall be interconnected to shut off the fuel supply when the suppression system is activated.

8.1.5.4* Combustible gas detector(s) shall be installed in the fuel cell power system enclosure, the exhaust system, or the room that encloses the fuel cell power system installation in accordance with the detector manufacturer's instructions and local regulation.

8.1.5.5* A combustible gas detector that meets the requirements of 8.1.5.4 shall be provided for all indoor or separately enclosed fuel gas compressors (fuel gas boosters).

8.1.5.6 When gaseous or liquefied hydrogen is piped into the room or area from outside, hydrogen detector(s) shall be installed in accordance with 8.1.5.7.

8.1.5.7 The following criteria for combustible gas detection systems, including detection specific to hydrogen, shall be met:

(1) The location of the detection device(s) shall be based on leakage sources and fuel type.
(2) The combustible gas detection system shall be arranged to alarm at 25 percent of the lower flammable limit (LFL) and be interlocked to shut down the power system fuel supply at 60 percent LFL.
(3) The LFL used shall be the lowest flammability limit of the gas or gas mixture.

8.1.5.8* Where leak detection is provided, fuel cell power systems that do not use gaseous fuels and do not generate flammable gas mixtures in any part of their systems shall not be required to have combustible gas detection to be installed.

8.1.5.9 Systems employing liquid fuels shall require leak detection.

8.2 Fire Prevention and Emergency Planning. A written fire prevention and emergency plan shall be provided and shall include the following, commensurate with the size and location of the fuel cell power system:

(1) Information on fire prevention procedures, plant emergency alarms, and egress procedures
(2) Requirements to conduct and document inspections and to identify and address needed remedial actions to correct conditions that increase fire hazards
(3) Descriptions of the general housekeeping practices and the control of transient combustibles
(4) Procedures for the handling and storage of flammable and combustible liquids and gases in accordance with NFPA standards applicable to the liquid or gas being used
(5) Procedures for the control of potential ignition sources, including smoking, grinding, welding, and cutting *(see NFPA 51B)*
(6) A procedure that addresses impairments to fire protection systems and other materials, systems, or equipment that affect the level of fire hazards associated with the installation and that also addresses at least identification of equipment not available for service, personnel to be notified, and required enhancement of fire surveillance
(7) Requirements needed to complete a fire report, including an investigation and a statement on the corrective action to be taken
(8) A listing of frequency and requirements for periodic inspection, testing, and maintenance of the fuel cell power system emergency systems
(9) Requirements for signage prohibiting smoking and nonprocess ignition services within protective enclosures and for signage that designates permitted smoking areas
(10) Requirements for posting of the location of the operating instructions and the location of the emergency controls
(11) Requirements for the availability of portable flammable gas detectors at the service entrance to the fuel cell power system installation
(12) Requirements for signage providing instructions on the types of fire-suppressing materials that are prohibited and where they are prohibited
(13) Requirements for a standard color or distinctive marking on all fuel piping and components, with marking in accordance with ANSI/ASME A13.1, *Scheme for the Identification of Piping Systems*
(14) Fire emergency plan that includes the following:
    (a) Response to fire alarms and fire system supervisory alarms
    (b) Notification of personnel identified in the plan
    (c) Evacuation of employees and visitors not directly involved in firefighting activities for the fire area
    (d) Coordination with security forces or other designated personnel to admit the public fire department and to control traffic and personnel
    (e) Fire preplanning that defines extinguishment activities and identification of fire water application concerns on operating equipment

(f) Periodic drills to verify viability of the plan
(g) Operator activities during fire emergencies
(h) Procedures for grounding, isolating, and/or discharging of energy sources
(i) Procedures for maintaining appropriate clearances to high-voltage electrical systems

Chapter 9 Fuel Cell Power Systems 50 kW or Less

9.1 Chapter Scope. This chapter identifies additional requirements or modifications to Chapters 1 through 8 as they relate directly to fuel cell power systems 50 kW or less.

9.2 Outdoor Installations.

9.2.1 The exhaust outlets of the system shall be located at least 3 m (10 ft) from HVAC air intakes, windows, doors, and other openings into buildings.

9.2.2 The exhaust outlet(s) shall not be directed onto walkways or other paths of travel for pedestrians.

9.3 Indoor Installations.

9.3.1 Fuel cell systems that are supplied by natural gas, propane, or fuel oil and that are located in residences shall not be required to have fire-rated separations.

9.3.2 Fuel cells that are supplied by methanol, ethanol, or other alcohol fuels and that are located in residences shall not be required to have fire-rated separations if the fuel cell power system meets requirements 9.3.6.1 through 9.3.6.4.

9.3.3 Clearances from combustible construction and other combustible materials shall be in accordance with manufacturer's instructions, NFPA 31, NFPA 54, or NFPA 58.

9.3.4 Indoor use of fuel cell power systems that operate without ventilation air from the outside shall be provided with limit controls that will not permit room ambient oxygen levels to drop below 18 percent unless it can be demonstrated by other means that the oxygen level will not drop below 18 percent.

9.3.5 The exhaust system materials shall be compatible with the exhaust gas and any resulting condensate.

9.3.6 Fuel cell power systems using a flammable liquid as a fuel shall be located outside unless they meet the requirements for indoor installations in Chapters 1 through 8 or meet all the requirements in 9.3.6.1 through 9.3.6.4.

9.3.6.1 The fuel cell power system enclosure plus the connected indoor liquid fuel piping shall contain less than 0.019 m^3 (5 gal) of liquid fuel during all modes of operation, standby, and shutdown.

9.3.6.2 The bulk fuel storage shall be located outside.

9.3.6.3 The indoor fuel piping shall be of solid pipe or tube or all-welded, soldered, or brazed construction up through the fuel cell power system enclosure.

9.3.6.4 The fuel cell power system shall be equipped with leakage detection and automatic isolation of the indoor fuel piping from the outdoor bulk fuel supply upon detection of fuel leakage using pump stoppage, valve closure, or other appropriate means as determined by the manufacturer. Outdoor bulk fuel storage located at an elevation above the fuel cell power system shall be equipped with an automatic isolation valve at the tank.

9.3.7 Fuel cell power systems that use hydrogen shall be installed in accordance with the manufacturer's instructions and NFPA 55.

9.3.7.1 Fuel cell systems supplied with a hydrogen fuel supply not exceeding a total of 11.33 m^3 (400 scf) shall not be required to have fire-rated separation.

9.4 Ventilation and Exhaust.

9.4.1 A direct-vented fuel cell power system operating at negative pressure with respect to the room shall not require additional mechanical exhaust from the room or area.

9.4.2 Where the total abnormal gas emission or concentration from the fuel cell power system is nontoxic and cannot attain 25 percent of LFL under normal room or area ventilation, the fuel cell power system shall not be required to supply additional ventilation and exhaust.

9.5 Fire Protection. The requirements of Chapter 8 shall not apply to 50 kW or smaller systems except as modified in 9.5.1 and 9.5.2.

9.5.1 Combustible gas detection shall be installed in accordance with 8.1.5.4 through 8.1.5.6 except where the fuel gas system is listed for indoor use and the fuel is odorized natural gas or LP-Gas.

Δ **9.5.2** Fuel cell power systems that do not meet the requirements of Section 4.2 or Section 4.3 shall require a written fire prevention and emergency plan in accordance with Section 8.2.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

Δ **A.3.2.1 Approved.** The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment, or materials, the "authority having jurisdiction" may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The "authority having jurisdiction" may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA standards in a broad manner because jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designa-

ted agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.5 Distributed Integrated Controls (DIC). The DIC is made up of a collection of modules, each with its own function, interconnected to process data for a specific operation or function. Also referred to as distributed control system (DCS).

A.3.3.6.2 Fire Risk Evaluation. The evaluation results in a list of required fire protection elements to be provided based on acceptable means for separation or control of common or special hazards (e.g., temperature and pressure), the control or elimination of ignition sources, the detection and suppression of fires, and the safeguarding of life.

A.3.3.12 Fuel Cell Power System. The system is composed of all or some of the systems shown in Figure B.1.

A.3.3.12.1 Engineered and Field-Constructed Fuel Cell Power System. The power system is engineered and designed for the assembly of various components from various sources and is installed on-site. *(See Figure B.1 for a schematic of a typical fuel cell power system.)*

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A.3.3.13.1 Digester Gas. Digester gas can contain approximately 50 percent methane and approximately 25 percent carbon dioxide (CO_2). Trace contaminants can include sulfur (S) and chlorine (Cl) compounds.

A.3.3.13.2 Landfill Gas. Landfill gas is approximately 50 percent methane and approximately 20 percent CO_2. Trace contaminants can include sulfur (S), chlorine (Cl), water (H_2O), and oxygen (O_2) introduced by air leakage into the collection system.

A.3.3.15.1 Indoor Installation. An indoor installation can be a separate building, room, or area within a building.

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A.4.1 Fuel cell technology is evolving. Early editions of the standard for testing fuel cell power systems, ANSI/CSA FC 1, *Fuel cell technologies — Part 3-100: Stationary fuel cell power systems — Safety*, limited designs by output power, fuels and construction techniques. ANSI/CSA FC 1 has matured so that its current edition has no limitation on output power, permits all credible fuels and fuel cell technologies, and allows designs to be packaged in a single enclosure or listed modules to be assembled on-site. Outside the scope of ANSI/CSA FC 1, there are one-of-a-kind designs that could possibly be constructed on-site. In the latter's case, engineered and field-constructed fuel cell power systems may be accepted at the site based on documentation. This documentation includes a fire risk evaluation that can be prepared by a registered engineer or by a third-party that is acceptable to the authority having jurisdiction. See Section 4.4, Engineered and Field-Constructed Fuel Cell Power Systems.

N **A.4.5.1** The provisions of 4.5.1 do not require inherently noncombustible materials to be tested in order to be classified as noncombustible materials. [**5000:**A.7.1.4.1]

N **A.4.5.1.1(1)** Examples of such materials include steel, concrete, masonry, and glass. [**5000:**A.7.1.4.1.1(1)]

N **A.4.5.2** Material subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition is considered combustible. *(See NFPA 259 and NFPA 220.)* [**5000:**A.7.1.4.2]

A.5.1.1(5) For additional information on hazardous atmospheres, see NFPA 497.

A.5.1.1(10) Installations should consider mechanical damage and exposure to falling ice and other objects.

A.5.1.2 The siting of a fuel cell power system depends on many variables relating to the unit size, fuel, and failure mode.

A.6.2.1.2 One method of doing so would be the use of check valves.

A.6.4 Hydrogen is a colorless, odorless, highly flammable gas or liquid. The flammable range in air at atmospheric pressure is 4.0 percent to 75 percent by volume. It has a vapor density of 0.1. Being lighter than air, it can dissipate in open areas but be very explosive in confined spaces. Hydrogen burns with an intensely hot nonluminous flame that makes it very difficult to judge the boundaries of a fire. Liquid hydrogen is similar to other cryogens that have a high liquid-to-gas volume expansion ratio [1 to 848 at 20°C (68°F)].

A.6.4.3.1 The shutoff valve should be in a location that is identified and easily accessed by authorized personnel such that the valve can be operated in the event of an impending emergency. A cylinder valve on unmanifolded cylinder storage installations meets the intent of 6.4.3.1.

A.6.4.3.2 The shutoff valve should be outside of the storage containment area in a location that is identified and easily accessed by authorized personnel such that the valve can be operated in the event of an impending emergency. An inlet shutoff valve on the fuel cell system meets the intent of 6.4.3.2.

A.6.5 Biogas consists primarily of methane (about 50 percent), carbon dioxide (about 40 percent), hydrogen sulfide, water, and small amounts of organic compounds, including halogenated compounds.

A.6.6 Examples of such liquid fuels include diesel, JP-4, JP-5, ethanol, and naphtha methanol.

A.7.1.2 The building ventilation and fuel cell power system and exhaust system design should consider the manufacturer's air requirements for the fuel cell power system(s) and any additional equipment that is located within the space.

A.7.2.1 This system is to remove exhaust air. This system can also be the source of supply for fuel cell power system ventilation air (primary, circulation, and dilution systems).

A.8.1.2 Units meeting ANSI/CSA FC 1, *Fuel cell technologies — Part 3-100: Stationary fuel cell power systems — Safety*, requirements have internal devices to monitor for overheating, and smoke and combustible gas releases, interlocked to shut down the fuel cell by isolating the fuel supply. The fire detection and alarm for engineered and field-constructed fuel cell power systems should provide for these internal hazards as well as hazards outside the fuel cell. If a fire alarm system is provided for the site or facility where a prepackaged and pre-engineered fuel cell is installed, the process monitors interlocked to shut down the fuel cell should be monitored by the fire alarm system.

A.8.1.5.2 The combination of curbs and drains should be sized to handle the combined discharge from automatic sprinklers and a fuel spill for a minimum of 10 minutes.

A.8.1.5.4 A fuel cell power system that includes an internal combustible gas detector meets this requirement if it is supported by a separate safety analysis.

A.8.1.5.5 Fuel gas boosters (within the fuel cell enclosure containing fuel) containing members are addressed in ANSI/CSA FC 1, *Fuel cell technologies — Part 3-100: Stationary fuel cell power systems — Safety*, as part of the leak detection and mitigation strategy.

A.8.1.5.8 An example of such a system is a direct methanol fuel cell power system.

Annex B Typical Fuel Cell Power System

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Fuel Cell Power System Schematic. Figure B.1 presents a generalized stationary fuel cell power system schematic. *(For more information, see the definitions of various types of fuel cell power systems in Section 3.3.)*

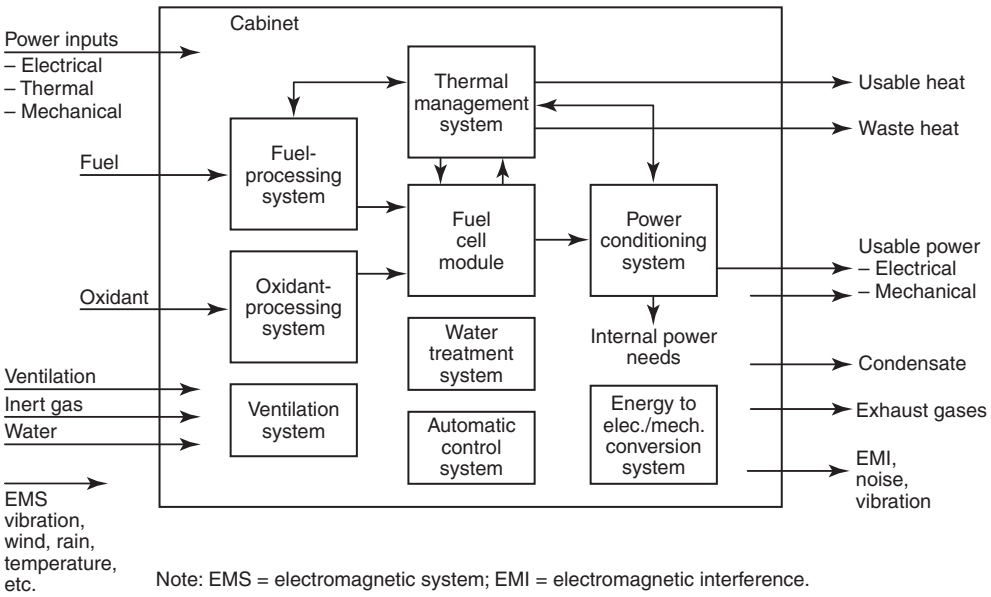

FIGURE B.1 Typical Fuel Cell Power System.