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Introductory note

Introductory note: This draft has been developed by WG 5 of IEC TC 105

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Stationary Fuel Cell Power Plants – Installation

IEC TC105, WG#5

Committee Draft Nr. 1

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Contents:

1.	Foreword.....	4
2.	Introduction	5
3.	Scope.....	5
4.	Normative References	6
5.	Terms and Definitions.....	7
6.	General safety requirements and strategy	9
7.	Siting Considerations.....	10
7.1	General Siting.....	10
7.2	Outdoor Installations.....	11
7.3	Indoor Installations.....	11
7.4	Rooftop Installation.....	12
8.	Ventilation and Exhaust	12
9.	Fire Protection.....	13
10.	Interconnections with Site Interfaces.....	13
10.1	Connections to Fuel Supplies and Storage Arrangements - General.....	14
10.2	Fuel Shut Off and Piping.....	14
10.3	Connections to auxiliary media supply and media disposal.....	14
11.	Plant Sizes.....	15
12.	Environmental requirements.....	15
13.	General Installation and Commissioning Plan.....	16
14.	Approval Tests.....	16
15.	Repeated Tests.....	17
16.	Documentation.....	17
16.1	Markings and Instructions.....	17
16.2	Inspection checklist	17
16.3	Installation manual.....	17
16.4	User's information manual.....	18
16.5	Maintenance manual	18
	Appendix 1:.....	19
	Approval Procedures	19

1. Foreword

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62282-3 has been prepared by IEC technical committee 105: Fuel cell technologies.

The text of this standard is based on the following documents:

FDIS	Report on voting
105/XX/FDIS	105/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 62282 consists of the following parts under the general title *Fuel cell technologies*:

Part 1: Terminology

Part 2: Fuel cell modules

Part 3: Stationary Fuel Cell Power Systems – Safety

Part 4: Stationary fuel Cell Power Systems – Performance

Part 5: Stationary Fuel Cell Power Systems – Installation

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be reconfirmed; withdrawn; replaced by a revised edition, or amended.

A bilingual version of this publication may be issued at a later date.

2. Introduction

This document covers the installation of stationary fuel cell power systems that are built in compliance with IEC 62282-3, Stationary Fuel Cell Power Systems - Safety.

The requirements of this standard are not intended to constrain innovation. Installations employing materials and/or methods differing from those detailed in this standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be considered to comply with the standard.

3. Scope

International standard providing minimum safety requirements for installation of stationary fuel cell power systems in compliance with IEC 62282-3 and associated interfaces, in particular

- a singular pre-packaged, self-contained power system,
- any combination of pre-packaged, self-contained power systems,
- power systems comprising two or more factory-matched modular components intended to be assembled in the field,
- engineered and field-constructed power systems,

intended for residential, commercial, municipal, and/or industrial use.

The standard applies to the installation of the mentioned systems intended

- for electrical connection to mains directly or with a transfer switch,
- for a stand-alone power distribution system.
- to provide AC or DC power.
- with or without the ability to recover useful heat.
- for operation on:
 - a) Natural gas and other methane rich gases derived from renewable (biomass) or fossil fuel sources, e.g. landfill gas, digester gas, coal mine gas.
 - b) Fuels derived from oil refining, e.g. diesel, gasoline, kerosene, liquefied petroleum gases such as propane and butane.
 - c) Alcohols, esters, ethers, aldehydes, ketones, Fischer-Tropsch liquids and other suitable hydrogen-rich organic compounds derived from renewable (biomass) or fossil fuel sources, e.g. methanol, ethanol, di-methyl ether, biodiesel.
 - d) Hydrogen, gaseous mixtures containing hydrogen gas, e.g. synthesis gas, town gas.

Both indoor and outdoor installations are addressed.

The standard does not cover:

- Fuel supply and/or fuel storage systems
- Power connector to the grid
- Portable fuel cell power systems.
- Propulsion fuel cell power systems.

- Transportation and APU (auxiliary power units) applications.

A typical stationary fuel cell power system installation is represented in figure 1.

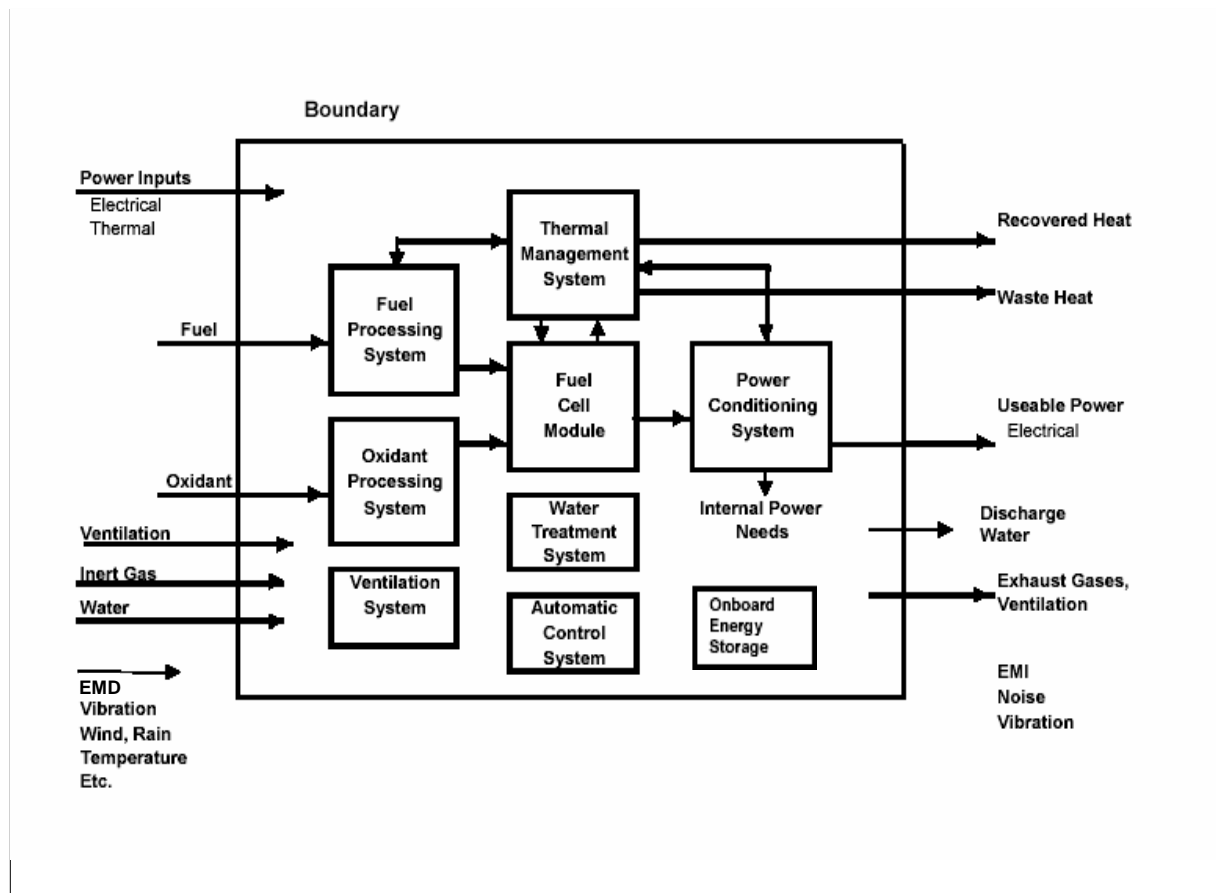


Fig. 1: Fuel Cell Power System

Fuel Cell Power Systems are distinguished into three categories:

- Small Systems
- Medium Systems
- Large Systems

Definition of these systems see chapter 11

4. Normative References

IEC 60079-10 Electrical apparatus for explosive gas for Explosive gas atmospheres – Part 10

IEC 60204-1 Electrical Equipment of Industrial Machines – Part 1: General requirements

IEC 60812 Analysis techniques for system reliability – Procedures for failure mode and effective analysis (FMEA)

IEC 61025 Fault tree analysis (FTA)

IEC 61511-3 Functional safety – Safety instrumented systems for the process industry sector – Part 3: Guidance for the determination of the required safety integrity levels

IEC 61882 Hazard and operability studies (HAZOP studies) – Application guide

IEC 62282-3 Stationary fuel cell power systems – Safety

ISO 14121 Safety of machinery – Principles of risk assessment

5. Terms and Definitions

- 5.1 Approved: Acceptable to the authority having jurisdiction.
- 5.2 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.
- 5.3 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.
- 5.4 Automatic Fire Sprinkler System. A sprinkler system of pipes with water under pressure that allows water to be discharged when a sprinkler head operates.
- 5.5 Biogas Fuel Cell System. A fuel cell system comprised of a conventional biogas source, such as an agricultural biogas plant or a landfill gas site or municipal sewage digester site, a fuel cell specific gas cleanup unit, and a fuel cell power system.
- 5.6 Damper. A valve or plate for controlling draft or the flow of gases, including air.
- 5.7 Digester Gas. The biogas derived by fermentation of organic material, such as sewage, animal and food waste and industrial organic materials.
- 5.8 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.
- 5.9 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.
- 5.10 Engineered and Field-Constructed Fuel Cell Power System. A fuel cell power system that is not preassembled or does not have factory-matched components.
- 5.11 Exhaust. Effluent removed from a fuel cell power system and not reused.
- 5.12 Exhaust System. A gas-conveying system for moving gases from a source to a point of discharge.
- 5.13 Fire Damper. A device, installed in an air distribution system, designed to close automatically upon detection of heat to interrupt migratory airflow and to restrict the passage of flame.
- 5.14 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.
- 5.15 Fire Prevention. Measures directed toward avoiding the inception of fire.

- 5.16 Fire Protection. Methods of providing for fire control or fire extinguishment.
- 5.17 Fuel Supply Interface: Interface point at boundary limits of plant, where fuel streams into the fuel cell power plant
- 5.18 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.
- 5.19 Indoor Installation. A fuel cell power system completely surrounded and enclosed by walls, a roof, and a floor.
- 5.20 Installation
- The location where a fuel cell power system is sited as a unit or built as an assembly.
The act to install a fuel cell power system
- 5.21 Interface Point of Delivery: Location, where media will be delivered to or disposed from the fuel cell power plant.
- 5.22 Landfill Gas. The biogas derived from decomposition of municipal solid waste (landfill).
- 5.23 Large Systems: Definition see chapter 11
- 5.24 Lower Explosive Limit (LEL). The lowest concentration of a flammable gas/vapor in air in which explosion is propagated.
- 5.25 Lower Flammable Limit (LFL). The lowest concentration of a flammable gas/vapour in air in which flame is propagated.
- 5.26 Medium Systems; definition see chapter 11
- 5.27 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.
- 5.28 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.
- 5.29 Non-combustible. Not capable of supporting combustion.
- 5.30 Outside or Outdoor Installation. A power system installation that is not an indoor installation
- 5.31 Portable Fuel Cell. A fuel cell generator of electricity, which 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.
- 5.32 Pre-Engineered and Matched Modular Components Fuel Cell Power System. A fuel cell power system that has components that are assembled in a factory in separate modules, such as the fuel cell stack, reformer, and inverter. The components are matched in the factory, shipped as modules and are reassembled in the field
- 5.33 Pre-packaged, Self-Contained Fuel Cell Power System. A fuel cell power system that is designed as one unit, assembled in a factory, and shipped to site.
- 5.34 Rooftop Installation. A power system installation located on the roof of a building. (This is an outdoor installation, not completely surrounded)
- 5.35 Room Ventilation Air: Air supply to the room for cooling, heating, makeup atmosphere, safety ventilation. This air can be taken from indoors or outdoors
- 5.36 Shall. Indicates a mandatory requirement.
- 5.37 Should. Indicates a recommendation or that which is advised but not required.
- 5.38 Small Systems; definition see chapter 11
- 5.39 Smoke Damper. A device that operates automatically, restricts the passage of smoke through a duct, and is controlled by a smoke detector.
- 5.40 Stationary. Permanently connected and fixed in place.

6. General safety requirements and strategy

The General Safety Strategy of this document is consistent with the Safety Strategy of IEC 62282-3 Stationary Fuel Cell Power Systems – Safety.

The Standard is limited to those conditions that can lead to personnel hazards or damage to equipment or property external to the Fuel Cell System.

Based on the quantity of fuel and other stored energy (e.g. flammable materials, pressurized media, electrical energy, mechanical energy, etc.) within the Fuel Cell Systems there is a need to eliminate potential hazards. The general safety strategy for the installation of the Fuel Cell Systems shall be established according to the following sequence:

- Avoid the possible release of combustible and/or toxic gases and pollutant gases, liquids and solids.
- Eliminate hazards outside the Fuel Cell System and the related installation, when such energy or gases are released nearly instantaneously,
- Provide appropriate safety markings, concerning the remaining risks of hazards.

Hazards

Using the techniques described above, special care shall be taken to address the following:

- **Mechanical Hazards** -- sharp surfaces, tripping hazards, moving masses and instability, strength of materials, and liquids or gases under pressure
- **Electrical Hazards** -- contact of persons with live parts, short circuits, high voltage
- **Thermal Hazards** -- hot surfaces, release of high temperature liquids or gasses, thermal fatigue
- **Fire and Explosion Hazards** -- flammable gases or liquids, potential for explosive mixtures during normal or abnormal operating conditions, potential for explosive mixtures during faulted conditions.
- **Malfunction Hazards** -- unsafe operation of installation related equipment due to failures of software, control circuit or protective/safety components or incorrect manufacturing or miss-operation
- **Material and Substance Hazards** -- material deterioration, corrosion, embrittlement, toxic releases, choking hazards (e.g. by superseding, replacing oxygen by inert purge gases)
- **Waste Disposal Hazards** -- disposal of toxic materials, recycling, disposal of flammable liquids or gases.
- **Environmental Hazards** -- unsafe operation in hot/cold environments, rain, flooding, wind, earthquake, external fire, smoke.

For medium and large power systems the installer shall ensure that:

- all foreseeable hazards, hazardous situations and events associated with the Fuel Cell System Installation have been identified,
- the risk for each of these hazards has been estimated or derived from the combination of probability of occurrence of the hazard and of its foreseeable severity as per ISO 14121, IEC 61882, or IEC 61511-3 as applicable, or equivalent.
- the probability and severity of each risk have been reduced as far as practicable,
- the necessary protection measures in relation to risks that cannot be eliminated have been taken (provision of warning and safety devices),

A reliability analysis for safety shutdown systems that have otherwise not been evaluated or certified by a third party, shall be performed in accordance with IEC 60812, IEC 61025, or equivalent.

7. Siting Considerations

7.1 General Siting

The fuel cell power system shall comply with IEC 62282-3 Stationary Fuel Cell Power Systems - Safety.

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:

It shall be placed and fixed firmly so that it will not be easily moved, toppled, or dislocated.

It shall be located and anchored so that the system and equipment will not be adversely affected by wind, and seismic events. It shall be protected so as not to be adversely affected by rain, snow, ice, water and or freezing temperatures, unless the system and installation equipment is designed for those conditions,..

Sites for medium and large power systems shall be protected against access by unauthorized persons commensurate with the location and installation environment. Fire department access shall be provided.

It shall be located outside of potentially hazardous atmospheres as defined by IEC 60079-10 (Electrical Apparatus for Explosive Gas atmospheres – Part 10: Classification of hazardous Areas), unless listed and approved for the specific installation.

It shall be sited so that the power system and equipment do not adversely affect building exits.

It shall be located so that the power system(s) and components of a fuel cell power system and their respective vent or exhaust terminations are separated from doors, windows, outdoor intakes, and other openings into a building to prevent introduction of exhaust gases into the building.

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

It shall be located in a manner that allows service, maintenance, and emergency access.

It shall be located away from combustible materials, hazardous chemicals, high-piled stock, and other exposures to fire hazards.

It shall be located or protected to prevent physical damage from moving vehicles or equipment.

Multiple power systems shall be located such that a fire or failure of one of the systems does not present an exposure hazard to adjacent power systems.

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 by Authority Having Jurisdiction

Discharged liquids shall be disposed according AHJ.

7.2 Outdoor Installations.

7.2.1 Air intakes to a fuel cell power system shall be located so that the plant is not adversely affected by other exhausts, gases, or contaminants. Air intakes to a fuel cell power system shall be kept unobstructed so their flow capacity is not affected by agglomeration of solids, dust, water, ice and snow.

7.2.2 Air intakes and exhaust to and from a fuel cell power system shall not impact travel on walkways or other paths of travel for pedestrians.

7.2.3 The exhaust outlet(s) from process areas or areas that contain fuel-bearing components of a fuel cell power system including outlets from relief valves shall be located in such a manner that it will not affect heating, ventilating, and air-conditioning (HVAC) air intakes, windows, doors, and other openings into buildings.

The area around outlets from fuel processes or compartments that contain fuel-bearing components and relief valves outlets shall be evaluated in accordance with the IEC 60079-10.

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

7.3 Indoor Installations.

7.3.1 Medium and Large fuel cell power systems

Indoor medium and large fuel cell power systems and its associated components shall be located in rooms that are protected with fire doors, fire dampers, and cable and piping penetrations that provide flame spread resistance consistent with the room construction. In particular

- the room shall be separated from the remainder of the building by floor, wall, and ceiling construction that has a fire resistance rating consistent with the relevant national standard,
- each room shall be provided with an exit consistent to the relevant national standard.

7.3.2 Small fuel cell power systems

Small fuel cell power systems shall not be required to have fire rated separations

7.4 Rooftop Installation.

Fuel cell power systems and components located on rooftops shall be installed in accordance with Section 7.2.

The material under and within 30 cm horizontally of a fuel cell power system or component shall be non-combustible or shall be tested or certified to afford an appropriate degree of fire protection to the roof deck.

8. Ventilation and Exhaust

8.1 General

- 8.1.1 All indoor fuel cell power systems shall be provided with ventilation and exhaust systems as noted below.
- 8.1.2 The ventilation systems shall be designed to provide a negative or neutral pressure in the room with respect to the building, where the fuel cell power system is located.
- 8.1.3 The intakes and exits of the ventilation and exhaust systems shall meet the requirements specified in 7.2.1, 7.2.2 and 7.2.3.

8.2 Ventilation

- 8.2.1 A separate mechanical ventilation system shall be provided for the room where fuel cell power systems are located. (separate from other rooms)
- 8.2.2 If it can be verified, natural ventilation shall be permitted to provide all required ventilation for small fuel cell power systems.
- 8.2.3 If mechanical ventilation is required for safety during normal operation, a control interlock shall be provided to alarm and/or shutdown the fuel cell power system upon loss of ventilation in accordance to IEC 60079-10.

8.3 Exhaust System

8.3.1 If mechanical ventilation is required for safety during normal operation, a control interlock shall be provided to shutdown the fuel cell power system upon loss of exhaust.

8.3.2 Small fuel cell power systems may be exempted from an exhaust system if it can be demonstrated to the satisfaction of the AHJ that the ventilation of the room is under all circumstances high enough

- to avoid higher concentrations of air free CO than 300 ppm, and
- 25% of the relevant LFL will not be exceeded, and
- the oxygen concentration will not be lower than 18 %.

8.4 Process Purging and Venting.

- 8.4.1 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. The clause 7.2.3 shall be obeyed. For small fuel cell systems the purging is permitted into room atmosphere, if it is ensured, that in maximum 25 % of the relevant LFL will not be exceeded and not exceed 300 ppm of CO air-free.
- 8.4.2 The vent shall be designed to prevent entry of water or foreign objects.

9. Fire Protection

9.1 Fire Protection and Detection.

9.1.1 Site Fire Protection.

- 9.1.1.1 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.
- 9.1.1.2 Fuel cell power systems located inside buildings shall be protected in accordance with 9.1.5.

9.1.2 Combustible gas detection

- 9.1.5.1 A combustible gas detection system shall be installed in the fuel cell power system enclosure or exhaust system or in the room containing fuel cell power system installations.
- 9.1.5.2 The following criteria for combustible gas detection systems shall be met:
- (1) 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.
 - (2) The LFL used shall be the lowest flammability limit of the gas or gas mixtures.
- 9.1.5.3 A combustible gas detector that meets the requirements of 9.1.5.2 shall be provided for all indoor or separately enclosed gas compressors.
- 9.1.5.4 The room or area where the fuel cell power system is installed shall have a hydrogen detector located where gaseous or liquefied hydrogen is piped into the room or area from outside. The gas detection system shall be arranged to alarm at 25 percent LFL and be interlocked to shut down the power system fuel supply at 60 percent LFL.

9.2 Fire Prevention and Emergency Planning.

A written fire prevention and emergency plan shall be provided if required by and in accordance to national standards.

10. Interconnections with Site Interfaces.

All interconnections including piping, electrical wiring and ducting between site interfaces and the fuel cell system shall be in accordance to relevant national standards.

10.1 Connections to Fuel Supplies and Storage Arrangements - General.

Fuel supply and fuel storage systems are not addressed by this standard. The installation and location of the interface point equipment downstream the fuel supply system and the associated fuel piping including the necessary components and their connection to the stationary fuel cell power system shall be in accordance with this chapter.

All gaseous fuel piping covered by this document shall be marked or identified in accordance with a relevant national standard.

10.2 Fuel Shut Off and Piping.

- An accessible shutoff valve shall be located in the fuel piping to the fuel cell power system within 1.8 m (6 ft) downstream interface point of delivery.
- A second accessible manual shutoff valve shall be located within 1.8 m (6 ft) upstream the power system but downstream the first one, unless the power system is enclosed by a room with a fire resistance rating as described in Section 7.3.
- If the power system is enclosed by a room described in Section 7.3, one valve shall be located outside the room.
- 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.
- Indoor areas classified as hazardous by IEC 60079-10, due to fuel piping, shall be provided with ventilation to the outdoors.
- Fuel containers and associated piping shall be electrically grounded and bonded.
- For indoor installation of a power system being fed by non-odorized gas mixtures, an automatic shutoff valve interlocked with gas detection shall be located outside the building that houses the power system in accordance with Chapter 7. The gas detection system shall be arranged to alarm at 25 percent LFL and be interlocked to shut down the power system fuel supply at 60 percent LFL.

10.3 Connections to auxiliary media supply and media disposal

Different fuel cell power systems need some auxiliary media supply and disposal for e. g. normal operation, safety reasons, start-up or shutdown procedures, purging or protection against internal damages. Water, nitrogen, carbon dioxide, hydrogen are typical auxiliary media for fuel cell power systems. As storage of these media is not part of the standard, only the interfaces shall be defined.

Combustible auxiliary gases:

A redundant safety system consisting of a quick-action shut-off valve controlled by the master control unit and an accessible second valve with an additional manual operability in the feed line are required in each system for combustible gases.

Non combustible or inert auxiliary gases: Connections according national standards

Water: Tap-water, recycled water. Connection according national standards

Waste water disposal. Connection according national standards

Safety blow-down pipe (not necessarily for small fuel cell systems): Connection according national standards.

11. Plant Sizes

From point of view concerning authority approval procedure three categories of plants with respect to plant size shall be considered:

1. **Small stationary power systems**, less than 10 kW net electrical output, intended for power supply and/or combined heat and power production with the focus on residential applications supplying single homes, clusters of residential houses, small stores, warehouses, small and medium enterprises, small and medium industry, etc.

Small stationary plants are equipped with a control system enabling at least fully automatic and unattended emergency shut down. Fully automatic operation including regular start-up and shut-down procedures are not required.

Small stationary fuel cell power systems are subject of approval tests as per chapter 14.

2. **Medium stationary power systems**, from 10 kW up to 500 kW el performances, intended for power supply and/or combined heat and power production in the medium power range. Typical applications are found e.g. in big office buildings, supermarkets, cold-stores, industrial, municipal applications and installations as decentralized combined heat and power production.

Medium stationary power systems mostly are equipped with a fully automated control system including start-up, shut-down and emergency shut-down procedures.

Medium stationary fuel cell power systems are subject of approval tests as per chapter 14 and repeated routine tests as per chapter 15.

3. **Large stationary power systems**, more than 500 kW el, intended for power supply and/or combined heat and power production with the focus on industrial, municipal and commercial applications, etc.

Large stationary fuel cell plants shall be operated by a master control unit using electrical and/or thermal requirements from grid or stand alone distribution network for control purposes, which can be superseded by safeguard personnel (not mandatory). These safeguard personnel shall be trained for reacting to the above mentioned hazards and shall be prepared to interact the automatic control system of the fuel cell plant.

Large stationary fuel cell power systems are subject of approval tests as per chapter 14 and repeated routine tests as per chapter 15.

12. Environmental requirements

Emissions, contaminants, and other environmental loads under normal operation, non-normal and failure modes operation are defined under IEC 62282-3, Stationary Fuel Cell Power Systems – Safety.

Requirements during installation and initial commissioning:

The following emissions during installation and initial commissioning shall not exceed levels as limited by applicable national regulations

- Noise
- Toxic and/or pollutant emissions
- Discharge of construction materials
- Auxiliary materials
- Binder burn out gases

If required by national regulations adequate facilities to reduce emissions during installation and commissioning of the fuel cell system have to be provided and operated.

13. General Installation and Commissioning Plan

Basis for authority approval for erection/installation/commissioning and operation of a fuel cell power plant employing fuel cells is a General Installation and Commissioning Plan. The installation and the initial commissioning of such Fuel Cell System shall be performed following such plan, which shall be authorized by Authority Having Jurisdiction (AHJ). This plan shall be developed by the manufacturer/integrator of the fuel cell system and shall describe in minimum the sequence of

- Civil construction work, if any,
- Integration of pre-packaged subsystems and/or components of the fuel cell system,
- Connection of subsystems and/or components by piping and wiring,
- Component/subsystem/system test,
- Initial commissioning.

The General Installation and Commissioning Plan shall refer the limitations of emissions and the discharge methods as defined in chapter 12.

14. Approval Tests

14.1 Gas Leakage

A gas leakage test is required for system-external items only. The gas leakage test shall be performed according to relevant national standards.

14.2 Grounding

All metallic parts as long as no live parts of the fuel cell system including system-external items shall be checked for proper grounding according IEC60204-1.

14.3 Site specific shutdown devices

Shutoff devices required by

- 8.2.1 and 8.2.3 (mechanical ventilation)
- 8.3.1 (mechanical exhaust)
- 9.1.5.1 and 9.1.5.2. (combustibility sensor)
- 9.1.5.4 (hydrogen sensor)
- 10.2 (hydrogen shutoff valve)

shall be demonstrated to function properly.

15. Repeated Tests

- 15.1 Repeated tests of system-external items will be part of normal periodic maintenance and performed according to manufacturer's instructions and national regulations

16. Documentation

16.1 Markings and Instructions

User Interface Markings. Where user interfaces are located up to a fuel cell power system or on a remote control unit connecting to the fuel cell power system, the input devices must be clearly identifiable in the local language. Any emergency devices must be marked following the local or national regulations.

16.2 Inspection checklist

- 16.2.1 An inspection checklist shall be included within the documentation package or contained within the installation manual. The inspection checklist is retained by the owner on site.

- 16.2.2 The installation checklist shall bear the following information:

- Installer's Company Name
- Installer's Name
- Date of Installation
- Location of Fuel Cell Power System Installation

- 16.2.3 The installation checklist shall include confirmation by signature of the installer of the proper installation of the following:

- Fuel supply connection requirements as prescribed in section 10.2
- Gas leakage test results as prescribed in section 14.1
- Connections to auxiliary equipment as prescribed in section 10.3
- Ventilation connections, construction, and testing of ventilation interlock as prescribed in section 8.1
- Exhaust connections, construction, and testing of ventilation interlock as prescribed in section 8.3
- Electrical Connections and grounding shall be as prescribed in section 14.2.
- External Safety Sensors as Applicable in section 9.1.5
- Process purge connections that are required by section 8.4

16.3 Installation manual

- 16.3.1 Reference is made to IEC 62282-3. Safety. The installation manual shall be supplied with the fuel cell power system and is written in the prevalent local language or multiple languages to include the prevalent local language. The installation manual is retained by the owner on site.

16.4 User's information manual

Reference is made to IEC 62282-3. Safety. The User's information manual shall be supplied with the fuel cell power system and is written in the prevalent local language or multiple languages to include the prevalent local language. The user's information manual is retained by the owner on site.

16.5 Maintenance manual

16.5.1 Reference is made to IEC 62282-3. Safety. The Maintenance manual shall be supplied with the fuel cell power system and is written in the prevalent local language or multiple languages to include the prevalent local language. The maintenance manual is retained by the owner on site.

16.5.2 The Maintenance manual shall be amended with maintenance information in particular to site specific equipment.

Informative Appendices:**Appendix 1:****Approval Procedures****Small Fuel Cell Power Systems:**

Small fuel cell systems shall be installed according to the Installation/Commissioning Plan defined by the manufacturer/integrator and approved by the Authority Having Jurisdiction (AHJ), provided that these systems and the appropriate Installation/Commissioning Plan are type tested according IEC 62282-3, Stationary Fuel Cell Power Systems – Safety, and approved by the authority having jurisdiction.

It is proposed that a general approval for installation/erection/commissioning and operation shall be given by the AHJ based upon product certification so, that an additional individual approval shall be not necessary, provided the system is serial manufactured and identical to the type tested one. The Installation/Commissioning Plan of the system as described under chapter 11.1 shall be subject of approval of the AHJ.

Medium Fuel Cell Power Systems

Medium fuel cell power systems shall be installed according the Installation/Commissioning Plan defined by the manufacturer/integrator and approved by the AHJ. It is proposed, that they shall be indicated for operation to the approval authority only, provided that these systems and the appropriate Installation/Commissioning Plan are type tested according IEC 62282-3, Stationary Fuel Cell Power Systems – Safety, and approved by the AHJ.

It is proposed that a general approval for installation/erection/commissioning and operation shall be given by the AHJ based upon product certification; an additional individual approval shall be not necessary any more, provided the system is serial manufactured and identical to the type tested one. The Installation/Commissioning Plan as described under chapter 11.1 of the system shall be subject of approval of the AHJ.

Medium stationary fuel cell plants shall be subject of repeated routine tests described under chapter 15.

Large Fuel Cell Power Systems:

It is proposed, that the approval for Installation/Erection of large fuel cell systems shall be given by the AHJ, provided

- the fuel cell system, which shall be installed, is compliant with the provisions of IEC 62282-3, Stationary Fuel Cell Power Systems – Safety,
- and the Installation/Commissioning Plan is approved by the AHJ,

The initial commissioning and the later operation of the plant shall be subject of approval by the AHJ under the precondition of fulfilment of the regulations of the Installation/Commissioning Plan described above and the successful performance of the approval tests as described in chapter 14.

Large stationary fuel cell plants shall be subject of repeated routine tests described under chapter 15.