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2007-04

Fuel cell technologies –

**Part 3-1:
Stationary fuel cell power systems –
Safety**

Technologies des piles à combustible –

**Partie 3-1:
Systèmes à piles à combustible stationnaires –
Sécurité**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FUEL CELL TECHNOLOGIES –

**Part 3-1: Stationary fuel cell power systems –
Safety**

FOREWORD

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International Standard IEC 62282-3-1 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
105/138/FDIS	105/143/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.

The list of all the parts of the IEC 62282 series, under the general title *Fuel cell technologies*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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FUEL CELL TECHNOLOGIES –

Part 3-1: Stationary fuel cell power systems – Safety

1 Scope

This part of IEC 62282 is a product safety standard suitable for conformity assessment as stated in IEC Guide 104:1997, ISO/IEC Guide 51:1999 and ISO/IEC Guide 7:1994.

This standard applies to stationary packaged, self-contained fuel cell power systems or fuel cell power systems comprised of factory matched packages of integrated systems which generate electricity through electrochemical reactions.

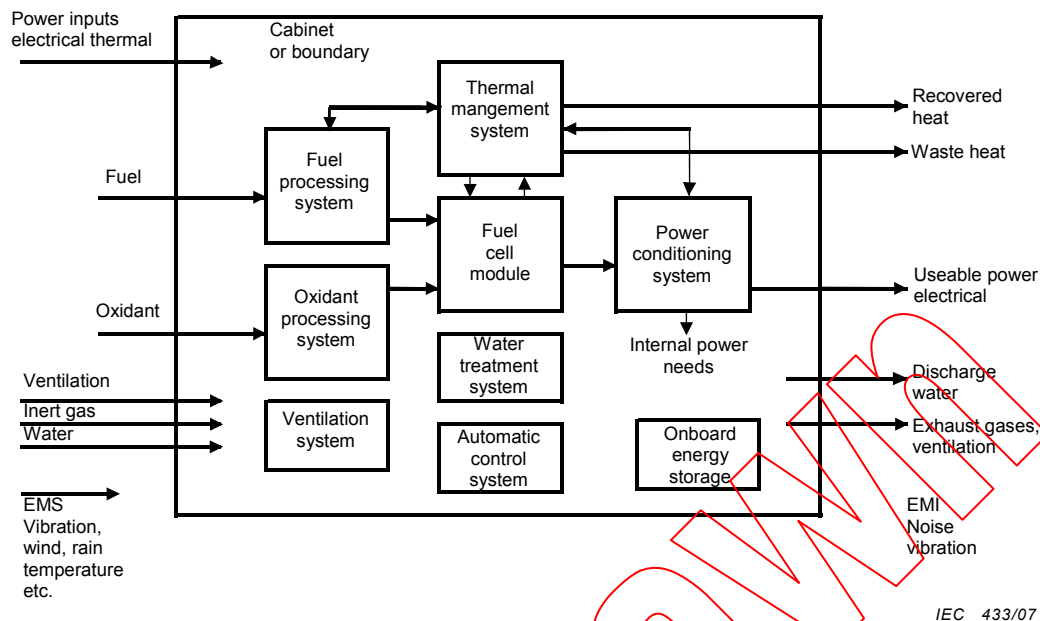
This standard applies to:

- systems intended for electrical connection to mains direct, or with a transfer switch, or to a stand-alone power distribution system;
- systems intended to provide a.c. or d.c. power;
- systems with or without the ability to recover useful heat;
- systems intended for operation on the following input fuels:
 - a) natural gas and other methane rich gases derived from renewable (biomass) or fossil fuel sources, for example, landfill gas, digester gas, coal mine gas;
 - b) fuels derived from oil refining, for example, 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, for example, methanol, ethanol, di-methyl ether, biodiesel;
 - d) hydrogen, gaseous mixtures containing hydrogen gas, for example, synthesis gas, town gas.

This standard does not cover

- portable fuel cell power systems;
- propulsion fuel cell power systems.

A typical stationary fuel cell power system is shown in Figure 1.



IEC 433/07

Figure 1 – Stationary fuel cell power systems

The overall design of the power system anticipated by this standard shall form an assembly of integrated systems, as necessary, intended to perform designated functions, as follows.

- Fuel processing system: Catalytic or chemical processing equipment plus associated heat exchangers and controls required to prepare the fuel for utilization within a fuel cell.
- Oxidant processing system: The system that meters, conditions, processes and may pressurize the incoming supply for use within the fuel cell power system.
- Thermal management system: Provides cooling and heat rejection to maintain thermal equilibrium within the fuel cell power system, and may provide for the recovery of excess heat and assist in heating the power train during startup.
- Water treatment system: Provides the treatment and purification of recovered or added water for use within the fuel cell power systems.
- Power conditioning system: Equipment which is used to adapt the electrical energy produced to the requirements as specified by the manufacturer.
- Automatic control system: The assembly of sensors, actuators, valves, switches and logic components that maintains the fuel cell power system parameters within the manufacturer's specified limits without manual intervention.
- Ventilation system: Provides, by mechanical means, air to a fuel cell power system's cabinet.
- Fuel cell module: Assembly of one or more fuel cell stacks, electrical connections for the power delivered by the stacks, and means for monitoring and/or control.
- Fuel cell stack: Assembly of cells, separators, cooling plates, manifolds and a supporting structure that electrochemically converts, typically, hydrogen rich gas and air reactants to d.c. power, heat, water and other byproducts.

- Onboard energy storage: Internal energy source intended to aid or complement the fuel cell module in providing power to internal or external loads.

This standard is applicable to stationary fuel cell power systems intended for indoor and outdoor commercial, industrial and residential use in non-hazardous (unclassified) areas.

This standard contemplates all significant hazards, hazardous situations and events, with the exception of those associated with environmental compatibility (installation conditions), relevant to fuel cell power systems, when they are used as intended and under the conditions foreseen by the manufacturer.

This standard deals with conditions that can yield hazards on the one hand to persons and on the other to damage outside the fuel cell system only. Protection against damage to the fuel cell system internals is not addressed in this standard, provided it does not lead to hazards outside the fuel cell system.

The requirements of this standard are not intended to constrain innovation. When considering fuels, materials, designs or constructions not specifically dealt with in this standard, these alternatives shall be evaluated as to their ability to yield levels of safety and performance equivalent to those prescribed by this standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60079-0, *Electrical apparatus for explosive gas atmospheres – Part 0: General requirements*

IEC 60079-2, *Electrical apparatus for explosive gas atmospheres – Part 2: Pressurized enclosures “p”*

IEC 60079-10, *Electrical apparatus for explosive gas atmospheres – Part 10: Classification of hazardous areas*

IEC 60079-16, *Electrical apparatus for explosive gas atmospheres – Part 16: Artificial ventilation for the protection of analyzer(s) houses*

IEC 60079-20, *Electrical apparatus for explosive gas atmospheres – Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus*

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60300-3-9, *Dependability management – Part 3: Application guide – Section 9: Risk analysis of technological systems*

IEC 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60335-2-51, *Household and similar electrical appliances – Safety – Part 2-51: Particular requirements for stationary circulation pumps for heating and service water installations*

IEC 60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60417, *Graphical symbols for use on equipment*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60730-1, *Automatic electrical controls for household and similar use – Part 1: General requirements*

IEC 60730-2-5, *Automatic electrical controls for household and similar use – Part 2-5: Particular requirements for automatic electrical burner control systems*

IEC 60730-2-6, *Automatic electrical controls for household and similar use – Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements*

IEC 60730-2-9, *Automatic electrical controls for household and similar use – Part 2-9: Particular requirements for temperature sensing controls*

IEC 60730-2-17, *Automatic electrical controls for household and similar use – Part 2-17: Particular requirements for electrically operated gas valves, including mechanical requirements*

IEC 60730-2-19, *Automatic electrical controls for household and similar use – Part 2-19: Particular requirements for electrically operated oil valves, including mechanical requirements*

IEC 60812, *Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)*

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61000-3-2, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic currents emissions (equipment input current ≤ 16 A per phase)*

IEC 61000-3-3, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*

IEC 61000-3-4, *Electromagnetic compatibility (EMC) – Part 3-4: Limits – Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A*

IEC 61000-3-5, *Electromagnetic compatibility (EMC) – Part 3-5: Limits – Limitation of voltage changes, voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current greater than 16 A*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61025, *Fault tree analysis (FTA)*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61511-1, *Functional safety – Safety instrumented systems for the process industry sector – Part 1: Framework, definitions, system, hardware and software requirements*

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 61779-4, *Electrical apparatus for the detection and measurement of flammable gases – Part 4: Performance requirements for group II apparatus indicating up to 100% lower explosive limit*

IEC 61779-6, *Electrical apparatus for the detection and measurement of flammable gases – Part 6: Guide for the selection, installation, use and maintenance of apparatus for the detection and measurement of flammable gases*

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

IEC 62086-1, *Electrical apparatus for explosive gas atmospheres – Electrical resistance trace heating – Part 1: General and testing requirements*

IEC 62282-2, *Fuel cell technologies – Part 2: Fuel cell modules*

IEC 62282-3-2, *Fuel cell technologies – Part 3-2: Stationary fuel cell power systems – Performance test methods*

IEC Guide 104:1997, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO 3864-2:2004, *Graphical symbols – Safety colours and safety signs – Part 2: Design principles for product safety labels*

ISO 4413, *Hydraulic fluid power – General rules relating to systems*

ISO 4414, *Pneumatic fluid power – General rules relating to systems*

ISO 5388, *Stationary air compressors – Safety rules and code of practice*

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ISO 10439, *Petroleum, chemical and gas service industries – Centrifugal compressors*

ISO 10440-1, *Petroleum and natural gas industries – Rotary-type positive-displacement compressors – Part 1: Process compressors (oil-free)*

ISO 10440-2, *Petroleum and natural gas industries – Rotary-type positive-displacement compressors – Part 2: Packaged air compressors (oil-free)*

ISO 10442, *Petroleum, chemical and gas service industries – Packaged, integrally geared centrifugal air compressors*

ISO 13631, *Petroleum and natural gas industries – Packaged reciprocating gas compressors*

ISO 13707, *Petroleum and natural gas industries – Reciprocating compressors*

ISO 13709, *Centrifugal pumps for petroleum, petrochemical and natural gas industries*

ISO 13850, *Safety of machinery – Emergency stop – Principles for design*

ISO 14121, *Safety of machinery – Principles of risk assessment*

ISO 14847, *Rotary positive displacement pumps – Technical requirements*

ISO 15649, *Petroleum and natural gas industries – Piping*

ISO/TR 15916, *Basic considerations for the safety of hydrogen systems*

ISO/TS 16528, *Boilers and pressure vessels – Registration of codes and standards to promote international recognition*

ISO/IEC Guide 7:1994, *Guidelines for drafting of standards suitable for use for conformity assessment*

ISO/IEC Guide 51:1999, *Safety aspects – Guidelines for their inclusion in standards*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 accessible

area to which, under normal operating conditions, one of the following applies.

- a) access can be gained without the use of a tool;
- b) the means of access is deliberately provided to the operator;
- c) the operator is instructed to enter regardless of whether or not a tool is needed to gain access

NOTE The terms "access" and "accessible", unless qualified, relate to operator access area as defined above.

3.2 circuit, extra low voltage (ELV)

secondary circuit with voltages between any two conductors of the circuit, and between any one such conductor and earth not exceeding 42,4 V peak, or 60 V d.c., under normal operating conditions, which is separated from hazardous voltage by basic insulation, and which neither meets all of the requirements for an SELV circuit nor meets all of the requirements for a limited current circuit

[IEC 60950]

3.3 circuit, limited current

circuit which is so designed and protected that, under both normal operating conditions and single-fault conditions, the current which can be drawn is not hazardous

[IEC 60950]

3.4 circuit, primary

circuit which is directly connected to the a.c. mains supply. It includes, for example, the means for connection to the a.c. mains supply, the primary windings of transformers, motors and other loading devices

[IEC 60950]

3.5 circuit, safety-control

circuit or portion thereof involving one or more safety controls in which failure due to grounding, opening or shorting of any part of the circuit can cause unsafe operation of the controlled equipment

3.6

circuit, safety extra low voltage (SELV)

secondary circuit which is so designed and protected that under normal operating conditions and single-fault conditions, its voltages do not exceed a safe value

[IEC 60950]

3.7

circuit, secondary

circuit which has no direct connection to a primary circuit and derives its power from a transformer, converter or equivalent isolation device, or from a battery

[IEC 60950]

3.8

circuit, telecommunications network voltage (TNV)

circuit which is in the equipment and to which the accessible area of contact is limited and that is so designed and protected that, under normal operating conditions and single-fault conditions, the voltages do not exceed specified limit values

[IEC 60950, 1.2.8.8 for specific limits]

3.9

class I equipment

equipment where protection against electric shock is achieved by

- a) using basic insulation;
- b) providing a means of connection to the protective earthing conductor in the building wiring to those conductive parts that are otherwise capable of assuming hazardous voltages if the basic insulation fails

NOTE Class I equipment may have parts with double insulation or reinforced insulation.

3.10

design pressure

pressure used in the design of a component together with the coincident design material temperature, for the purpose of determining the minimum permissible thickness or physical characteristics

3.11

effluent

products of combustion plus the excess air being discharged from gas utilization equipment (also see flue gases)

3.12

electrical equipment

see 3.14

3.13

ELV circuit

see 3.2

3.14

equipment, electrical

general term including material, fittings, devices appliances, fixtures, apparatus and the like used as part of, or in connection with, and electrical installation

3.15

flame failure lock-out time

see 3.31