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Responsible committee: GEL/9 Railway Electrotechnical Applications

Interested committees:

Title: BS EN IEC 63341-1 Railway applications- Rolling stock - Fuel cell systems for propulsion

Part 1: Fuel Cell System

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Responsible Committee Secretary: **Ms Bash Berry (BSI)**Direct tel: **0203 142 5620**E-mail: **bash.berry@rssb.co.uk**

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: IEC 63341-1 ED1	
DATE OF CIRCULATION: 2024-03-08	CLOSING DATE FOR VOTING: 2024-05-31
SUPERSEDES DOCUMENTS: 9/2914/CD, 9/2956A/CC	

IEC TC 9 : ELECTRICAL EQUIPMENT AND SYSTEMS FOR RAILWAYS	
SECRETARIAT: France	SECRETARY: Mr Denis MIGLIANICO
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 105	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING Attention IEC-CENELEC parallel voting The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE: Railway applications – Rolling stock – Fuel cell systems for propulsion – Part 1: Fuel cell system

PROPOSED STABILITY DATE: 2028

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS –
HYDROGEN AND FUEL CELL SYSTEMS FOR ROLLING STOCK****Part 1: Fuel Cell Power System**

FOREWORD

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International Standard IEC 62XXX has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
9/XX/FDIS	9/XX/RVD

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

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

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

reconfirmed,

withdrawn,

replaced by a revised edition, or

amended.

The National Committees are requested to note that for this document the stability date is 20XX.

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

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INTRODUCTION

This standard considers general requirements for all fuel cell power systems installed onboard rolling stock for railway applications.

TC105 decided to start work on generic fuel cell technologies covering different industrial sectors:

- IEC 62282 series: Fuel Cell Technologies:
 - IEC 62282-2-series: Fuel Cell Modules
 - IEC 62282-3-series: Stationary fuel cell power systems
 - IEC 62282-4-series: fuel cell power systems for electrically powered industrial trucks

These standards are often generic and do not cover the specific requirements for railway applications.

Therefore, this standard is developed for specifying the requirements for railway applications.

In addition, TC 9 has developed the following standards for the subsystems, which are related or have interfaces to the fuel cell power system.:

- IEC 62864-1:2016, Railway applications – Rolling Stock – Power Supply with onboard energy storage system – Part: 1 Series hybrid system
- IEC 61287-1, Railway applications – Power converters installed onboard rolling stock- Part 1: Characteristics and test methods
- IEC 60349 series, Electrical traction – rotating electrical machines for rail and road vehicles
- IEC 62928, Railway applications – rolling stock equipment – onboard lithium-ion traction batteries

IEC 62864-1:2016 specifies the general requirements for the onboard energy storage system as a system level. The hierarchy of standards is shown in Figure 1.

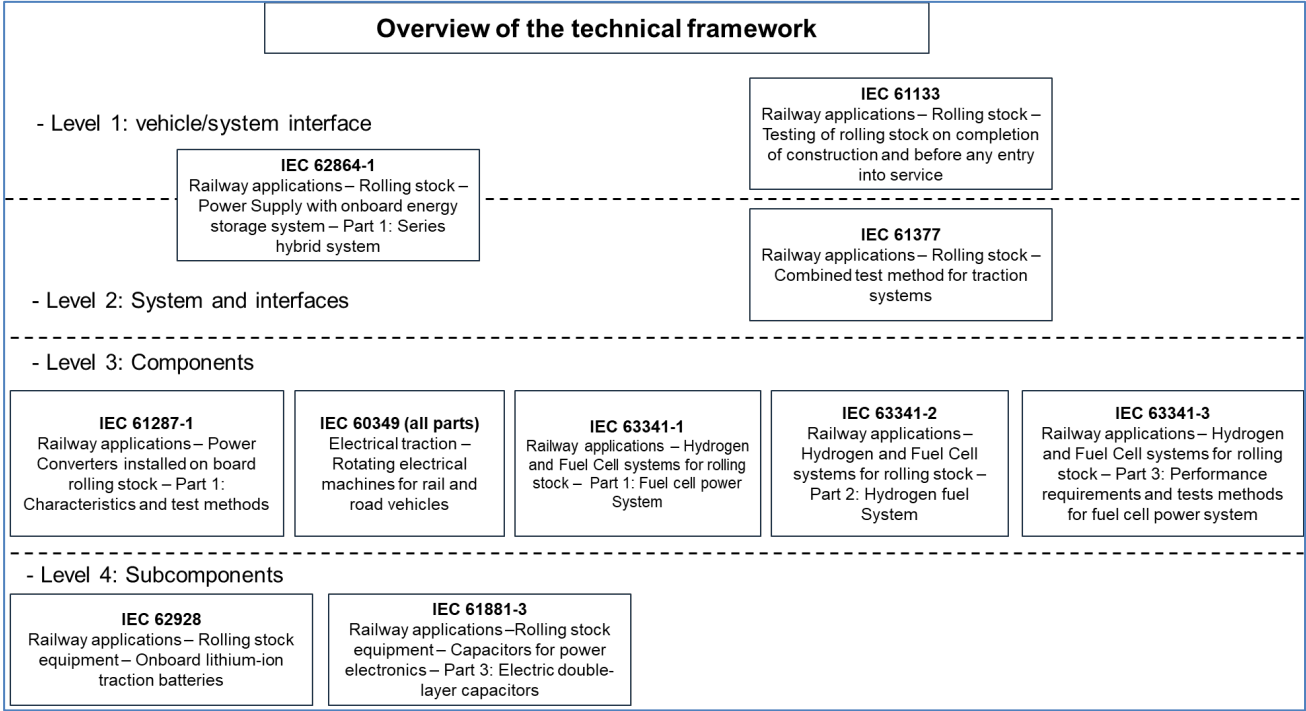


Figure 1: Hierarchy of standards related to IEC 63341

The standards listed in Figure 1 are not exhaustive.

IEC 63341 series consists of the following parts:

- Part 1: Fuel Cell Power System (FCPS)
- Part 2: Hydrogen Fuel System (HFS)
- Part 3: Performance requirements and test methods for fuel cell power system

RAILWAY APPLICATIONS – HYDROGEN AND FUEL CELL SYSTEMS FOR ROLLING STOCK

Part 1: Fuel Cell Power System

1 Scope

This standard applies to fuel cell power system installed onboard rolling stock for railway applications (e.g. light rail vehicles, tramways, streetcars, metros, commuter trains, regional trains, high speed trains, locomotives). Fuel cell power systems specified in this standard are used for the traction power and the auxiliary supply of railway vehicles such as hybrid vehicles as defined in IEC 62864-1:2016, and in case of use as an auxiliary onboard power source.

This standard applies to the fuel cell technology called PEMFC: Proton Exchange Membrane Fuel Cell, with the use of hydrogen as fuel source and the use of air as oxidant source.

This standard is linked to IEC 63341-3 part defined as “Railway applications - Hydrogen and Fuel cell systems for rolling stock - Part 3: Performance requirements and tests methods for fuel cell power system”. IEC 63341-3 describes the performance test method to validate the FCPS performance.

Hydrogen fuel system described in IEC 63341-2 is not considered as a part of the fuel cell power system.

Power conversion equipment is described in IEC 61287-1 and will be not considered in this document.

This standard focuses on:

- the scope of supply and the description of the interfaces (fluidic, electrical, thermal and mechanical) of the fuel cell power system,
- the description of the environmental conditions,
- the specification and description of all the requirements to ensure the fuel cell power system compliancy with a railway application,
- the process to validate the fuel cell power system sizing required for a specific load profile,
- the safety, reliability and protection requirements to design the fuel cell power system for railway application,
- the marking and labelling requirements,
- the requirements related to storage, transportation, installation and maintenance,
- the tests (type, routine and investigation) required to validate the fuel cell power system

This standard with the other parts is used in conjunction with other related IEC standards for auxiliary equipment used for railway rolling stock applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 62498-1:2010, Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock - Edition 1.0

IEC 61373: Railway applications – Rolling stock equipment – Shock and vibration tests - Edition 2.0; Incorporates Corrigendum 10/2011

IEC 60077-1: Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules - Edition 2.0

IEC 60529: Degrees of Protection Provided by Enclosures (IP Code) - Edition 2.0

IEC 62236-3-2: Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus

IEC 60617, Database : Graphical symbols for diagrams

IEC 61991: Railway applications – Rolling stock – Protective provisions against electrical hazards - Edition 2.0

IEC 60571: Railway applications – Electronic equipment used on Rolling stock Rolling stock – Electronic equipment

IEC 60349-2: 2010, Electric traction – Rotating electrical machines for rail and road vehicles – Part 2: Electronic converter-fed alternating current motors - Edition 3.0

IEC 60349-4:

IEC 60751: Industrial platinum resistance thermometers and platinum temperature sensors - Edition 2.0

IEC 62497-1: Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment - Edition 1.1;

IEC 62635 - Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment

ISO 21106 - Railway applications — Recyclability and recoverability calculation method for rolling stock

ISO 14687: 2019, Hydrogen fuel quality – Product specification

ISO 9227: Corrosion tests in artificial atmospheres — Salt spray tests

IEC 60034-14: Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity - Edition 4.0

IEC 62282-2-100: 2020, Fuel cell technologies - Part 2-100: Fuel cell modules – Safety

IEC 62282-3-100: 2019, Fuel cell technologies – Part 3-100: Stationary fuel cell power systems – Safety - Edition 2.0

- 132 *IEC 62282-4-101:2022, Fuel cell technologies – Part 4-101: Fuel cell power systems for propulsion*
133 *other than road vehicles and auxiliary power units (APU) – Safety of electrically powered industrial*
134 *trucks - Edition 1.0*
135
- 136 *ISO 7010: 2019 Graphical symbols – Safety colours and safety signs – Registered safety signs (ISO*
137 *7010:2019)*
138
- 139 *ISO 3744: 2010, Acoustics — Determination of sound power levels and sound energy levels of noise*
140 *sources using sound pressure — Engineering methods for an essentially free field over a reflecting*
141 *plane*
142
- 143 *ISO 3746: 2011, Acoustics - Determination of sound power levels and sound energy levels of noise*
144 *sources using sound pressure - Survey method using an enveloping measurement surface over a*
145 *reflecting plane*
146
- 147 *IEC 61709: 2019, Electric components – Reliability – Reference conditions fo failure rates and stress*
148 *models for conversion - Edition 3.0*
149
- 150 *ISO 9223: 2012, Corrosion of metals and alloys - Corrosivity of atmospheres - Classification,*
151 *determination and estimation*
152
- 153 *Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*

3 Terms, definitions and abbreviated terms

For the purpose of this standard IEC 63341-1, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Definitions

3.1.1

fuel cell power system

FCPS

generator system that uses one or more fuel cell power modules to generate electric power and heat

Note 1 to entry: This system typically contains the following subsystems: fuel cell power module, oxidant management system, fuel management system, thermal management system, exhaust management system, electrical and power management system, and their monitoring & control system.

[SOURCE: IEC 60050-485:2020, 485-09-01 modified – “fuel cell modules” has been replaced with “fuel cell power modules”. The note 1 to entry has been added.]

3.1.2

fuel cell stack

FCS

equipment assembly of two or more cells, separators, cooling plates, manifolds and a support structure that electrochemically converts, typically, hydrogen rich gas and air reactants to electric power, heat and other reactant bi-products

[SOURCE: IEC 60050-485:2020 485-06-01, modified – “equipment”, “two or more”, “bi” have been added. “supporting” has been replaced with “support”. “hydrogen-rich” has been replaced with “hydrogen rich”. “DC” has been replaced with “electric”. “reaction” has been replaced with “reactant”.]

3.1.3

fuel cell <fuel cell technologies>

FC

electrochemical device that converts the chemical energy of a fuel and an oxidant to electrical energy (DC power), heat and reaction products

Note 1 to entry: The fuel and oxidant are typically stored outside of the fuel cell and transferred into the fuel cell as they are consumed.

[SOURCE: IEC 60050-485:2020, 485-08-01, modified – “electric” has been replaced with “electrical”. Definition adapted for the context of fuel cell technologies and note to entry added]

3.1.4

fuel cell power module

fuel cell module

FCPM

assembly incorporating one or more fuel cell stacks and other main and, if applicable, additional components, which is intended to be integrated into a power system

Note 1 to entry: A fuel cell module can contain the following equipment: its control system and in option, the cell voltage monitoring device, the fuel recirculation device, the humidification device for reactants, sensors, valves and actuators. This subsystem is a part of the fuel cell power system.

[SOURCE: IEC 60050-485:2020, 485-09-03, modified : “fuel cell power module” has been added as the

preferred term and the term “fuel cell module” has become synonymous. “other main and” has been added. “that” has been replaced with “which”. “or a vehicle” has been removed. The note 1 to entry has been modified]

3.1.5

oxidant management system

OMS

system including filtering and pressuring equipment (and in option humidifying equipment), sensor and valve, able to manage the incoming oxidant such as air from the environment (as an example) to supply the FCPM (or fuel cell stack).

Note 1 to entry : This subsystem is a part of the fuel cell power system

3.1.6

fuel management system

FMS

system including filtering and depressuring equipment, sensor and valve able to manage the incoming fuel from the hydrogen fuel system to supply the FCPM (or fuel cell stack).

Note 1 to entry : This subsystem is a part of the fuel cell power system.

3.1.7

thermal management system

TMS

thermal loop including pump, heat exchanger, fan, heater, sensors and valves, (and in option ion removal device) able to manage the temperature of the fuel cell power system and coolant for cooling purpose and heating purpose.

Note 1 to entry : This subsystem is a part of the fuel cell power system

3.1.8

exhaust management system

ExMS

fluidic circuit able to manage the gas exhaust from the fuel cell power system to the environment.

Note 1 to entry : This subsystem is a part of the fuel cell power system

3.1.9

electrical and power management system

EPMS

electrical distribution able to supply power for the auxiliary equipment within the fuel cell power system and to deliver the power to the power converter.

Note 1 to entry : This subsystem is a part of the fuel cell power system

3.1.10

monitoring and control system

MCS

system including the monitoring device, the control and communication units to manage the different subsystems of the FCPS (FMS, OMS, FCPM, TMS, EPMS, ExMS) and to communicate with the external systems and vehicle control.

Note 1 to entry : This subsystem is a part of the fuel cell power system

3.1.11

hydrogen fuel system

HFS

system designed to store Hydrogen and to process it to supply the fuel cell power system.

Note 1 to entry : It includes the refuelling on-board devices, fuel lines and the associated monitoring & control & safety devices

3.1.12

energy storage unit**ESU**

physical equipment which is comprised of energy storage technologies such as batteries, EDLC, Flywheel,

[SOURCE: IEC 62864-1:2016, 3.1.20]

3.1.13**energy storage system****ESS**

physical equipment which consists of one or more ESUs and the other equipment required to connect to the DC link such as converters, control and monitoring systems, inductors, protection devices, cooling systems.

[SOURCE: IEC 62864-1:2016, 3.1.22]

3.1.14**power converter**

operative unit for electronic power conversion, comprising one or more electronic valve devices, transformers and filters if necessary and auxiliaries if any

Note 1 to entry: It can be DC/DC converter (insulated type) or chopper (non insulated type).

[SOURCE: IEC 60050-551:1998, 551-12-01 modified – The note 1 to entry has been modified]

3.1.15**hybrid vehicles**

vehicle that can store energy in an onboard ESS and is driven by using the stored energy as well as electric power from a generator or overhead lines / third rail

[SOURCE: IEC 62864-1:2016, 3.1.14 modified]

3.1.16**purge - gas purge <*in fuel cells>**

protective operation to remove gases and/or liquids, such as hydrogen, air or water, from a fuel cell power system

[SOURCE: IEC 60050-485:2020, 485-09-10, modified – “or liquids, or both” has been replaced with “and/or liquids”.

3.1.17**continuous grade of release**

release which is continuous or is expected to occur frequently or for long periods

Note 1 to entry: Both “frequently” and “long” are the terms which are intended to describe a very high likelihood of a potential release. In that respect, those terms do not necessarily need to be quantified.

[SOURCE: IEC 60050-426:2020, 426-03-10, modified – The note 1 to entry has been added.]

3.1.18**secondary grade of release**

release which is not expected to occur in normal operation and, if it does occur, is likely to do so only infrequently and for short periods

[SOURCE: IEC 60079-10-1:2015, 3.4.4]

3.1.19**explosive atmosphere**

mixture with air, under atmospheric conditions, of flammable substances in the form of gas or vapour, which, after ignition, permits self-sustaining flame propagation

[SOURCE: IEC 60079-10-1:2015, 3.2]

3.1.20

pressure relief device

PRD

pressure activated device used to prevent the pressure from rising above a predetermined maximum and thereby prevent failure of a pressurized part or system

[SOURCE: 62282-4-101:2014, 3.19]

3.1.21

safety critical component

component, device, circuit, software or similar part whose failure would affect the safety of the fuel cell power system as determined in 9.2

[SOURCE: 62282-4-101:2014, 3.22]

3.1.22

end of life <for fuel cell power systems>

EOL

point at which the fuel cell power system cannot fulfil the required functionality or operational pattern as initially agreed among the user and the manufacturers.

Note 1 to entry : As an example, point at which the fuel cell stack voltage drops below the specified minimum value, or at which the H₂ consumption increases above the specified maximum value.

[SOURCE: IEC 62864-1:2016, 3.1.15, modified: “ESU” has been replaced with “fuel cell power system”. The note 1 to entry has been added]

3.1.23

beginning of life

BOL

point at which the fuel cell power system has the rated performances fully available required by the user at manufacturer's delivery

[SOURCE: IEC 62864-1:2016, 3.1.16, modified: “ESU has been replaced with “fuel cell power system”. “capacity or energy” has been replaced with “performances”. “as minimum performance” has been replaced with “required by the user”]

3.1.24

manufacturer <of a fuel cell system>

organization which has the technical and commercial responsibility for its scope of supply

[SOURCE: IEC 62973-1: 2018, 3.1.13 modified – The note 1 to entry has been omitted.]

3.1.25

user <of a fuel cell system>

organization which will integrate and/or use the fuel cell power system.

Note 1 to entry : This can be the train integrator / manufacturer or train operator / railway undertaking

3.1.26

ultimate strength pressure

maximum pressure specified by the manufacturer which the FCPS can withstand without any damage or permanent loss of functional properties

Note 1 to entry : the ultimate strength pressure is expressed in Pa

[SOURCE: IEC 62282-3-100:2019, Table 3]

3.1.27**maximum operating pressure****MOP**

highest pressure that is expected for a component or system during normal operation

[SOURCE: IEC62282-4-101, 3.16 modified: Note 1 to entry has been removed]

3.1.28**minimum operating pressure****MnOP**

lowest gauge pressure of a component or system that is expected during normal operation

3.1.29**high pressure**

pressure at which the hydrogen fuel system stores the hydrogen

3.1.30**medium pressure**

pressure at which the hydrogen is distributed on the vehicle between the HFS (3.1.11) and the FCPS

3.1.31**low pressure**

pressure at which operates the fuel cell stack

3.1.32**lower flammable limit****LFL**

minimum concentration of fuel in a fuel air mixture where a combustion can be ignited by an ignition source

Note 1 to entry: A fuel-air mixture is flammable when combustion can be started by an ignition source. The main component concerns the proportions or composition of the fuel-air mixture. A mixture that has less than a critical amount of fuel, known as the lower flammability limit (LFL) or more than a critical amount of fuel, known as the rich or upper flammability limit (UFL), will not be flammable

[SOURCE: IEC 62282-2-100: 2020, 3.15]

3.1.33**gross power <for fuel cell power system>**

DC outlet power of operationnal FCS in a fuel cell power system

Note 1 to entry : the gross power is expressed in W

Note 2 to entry: Figure 2 shows typical power distribution of a fuel cell power system. Power indicates either electric active power or thermal power. This note applies to definition 3.1.32 to 3.1.41.

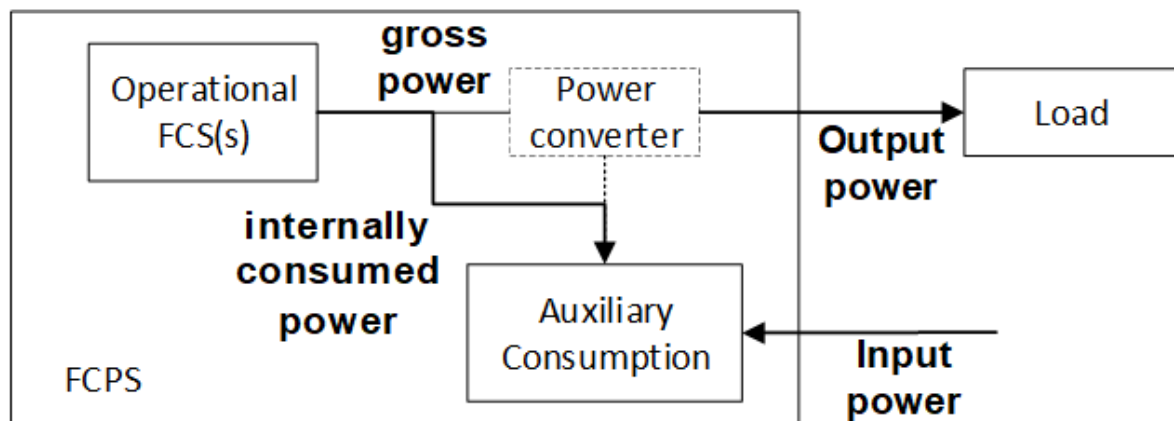


Figure 2: FCPS Power distribution

“[SOURCE: IEC 60050-485:2020, 485-14-01, modified – “of a fuel cell stack” replaced by “FCPS”. The note 1 to entry has been omitted. A new note 1 to entry has been added related to Figure 2 associated to the definition of the term.]”

3.1.34

output power <for fuel cell power system>

power generated by FCPS and available for external use

Note 1 to entry: $\text{FCPS Output Power} = \text{FCPS Gross Power} - \text{Internal Consumed Power}$

3.1.35

input power- <for fuel cell power system>

power from outside needed for the operation of the FCPS, consumed by the auxiliaries which are not internally supplied at FCPS level.

Note 1 to entry: The consumption of the auxiliaries is part or all provided by the input power.

3.1.36

net power <for fuel cell power system>

remaining power generated by FCPS useable in totality for external use

Note 1 to entry: $\text{Net power} = \text{output power} - \text{input power}$

3.1.37

auxiliary consumption

power consumed by all the FCPS auxiliaries necessary for the FCPS operation, which is the sum of the input power and the internally consumed power

Note 1 to entry: $\text{Auxiliary consumption} = \text{gross power} - \text{output power} + \text{input power}$

3.1.38

internally consumed power

power consumed internally by the FCPS auxiliaries

Note 1 to entry: internally consumed power could be zero

3.1.39

minimum power

minimum output power at which the FCPS can operate (for transient operation)

Note 1 to entry: If the operation with minimum power is limited in time, the maximum duration shall be specified

3.1.40

idle power

minimum output power at which the FCPS can operate continuously in a stable manner

Note 1 to entry: Idle Power can be identical or higher than minimum power.

3.1.41

maximum power

maximum output power at which the FCPS can operate (for transient operation)

Note 1 to entry: if the operation with maximum power is limited in time, the maximum duration shall be specified

3.1.42

rated power

maximum continuous output power that the FCPS is designed to generate, established for a specific set of operating conditions specified by the manufacturer

[SOURCE: IEC 60050-485:2020, 485-14-04]

3.1.43

polarisation curve

plot of the output voltage as a function of the output current at define reaction conditions for FCS, FCPM or FCPS

Note 1 to entry: The polarization curve is expressed in V versus A.

[SOURCE: IEC 60050-485:2020, 485-15-06]

3.1.44

piping and instrumentation diagram

P&ID

detailed diagram showing the piping and process together with instrumentation and control devices

3.1.45

load profile

electric power against time of occurrence to illustrate the variance in a load during a given time interval

[SOURCE: IEC 60050-617:2009, 617-04-05, modified – “curve representing supplied” has been removed.]”

3.1.46

storage state

state of a FCPS being non-operational and possibly requiring, under conditions specified by the manufacturer, the input of thermal and/or electric energy and/or an inert atmosphere in order to prevent deterioration of the components

Note 1 to entry : : this is a Sub-state of the OFF state

“[SOURCE: IEC 60050-485:2020, 485-21-06, modified – “energy, electric energy or” has been replaced with “and/or electric energy and/or”. “or any combination thereof” has been removed.]

3.1.47

OFF state

state of FCPS with no input power and no output power.

Note 1 to entry: The presence or not of hydrogen in FMS and air in OMS should be agreed between the user and the manufacturer.

Note 2 to entry: Figure 3 show typical state diagram for the FCPS. This figure provides definitions for the different states and phases. This note applies to definition from 3.1.46 to 3.1.60.

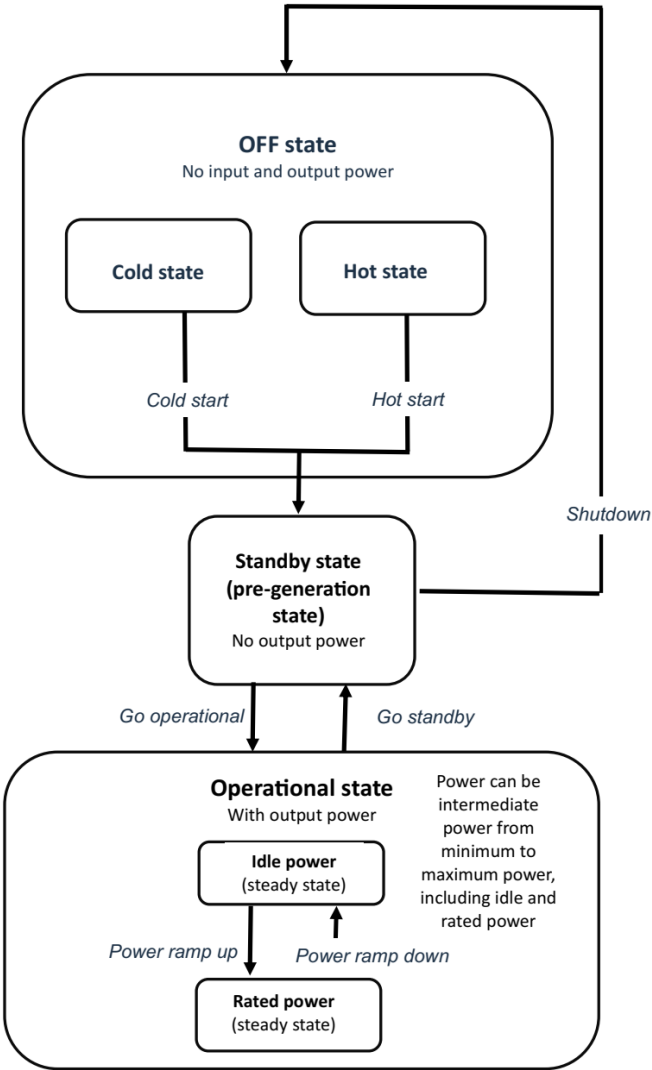


Figure 3: Typical state diagram for the FCPS

3.1.48 cold state
state of a fuel cell power system at ambient temperature with no power input or output

Note 1 to entry : this is a Sub-state of the OFF state

[SOURCE: IEC 60050-485:2020, 485-21-01]

3.1.49 hot state
state of a fuel cell power system with no input power or output power at the targeted temperature to start the FCS

Note 1 to entry : this is a Sub-state of the OFF state

3.1.50 first start
transient phase (if required) to start the FCPS after storage state

Note 1 to entry : Possible actions:
- Heat-up the cooling circuit up to the minimum temperature
- Replace inert gas at anode side by hydrogen with a sufficient quantity