DELIVERABLE D5.8

Proposal for a Standardized Stack-System Interface Presented to IEC

DISSEMINATION LEVEL: PUBLIC

Grant Agreement no 101006667
Research and Innovation Actions (RIA) project
Granted by:
Fuel Cells and Hydrogen 2 Joint Undertaking (JU)

Document Control Sheet

Project	**SO-FREE** Solid oxide fuel cell combined heat and power: Future-ready Energy
Grant Agreement n.	101006667
Document Title	Deliverable D5.8 Proposal for Standardized stack-system interface presented to IEC
Lead Beneficiary	Kiwa
WP number	WP5
Type	Report
Dissemination level	Public

Version	Date	Description
0.1	19/05/2026	

Date	20/05/2026
Number of pages	
Archive name	D5.8
Authors	Stephen McPhail (KIWA)
Contributors	
Reviewer(s)	Francesca Santoni (ENEA)

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (JU) under grant agreement No 101006667. The JU receives support from the European Union's Horizon 2020 research and innovation program and Italy, Austria, Finland, Germany, Poland, Netherlands, United Kingdom.

Table of contents

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (JU) under grant agreement No 101006667. The JU receives support from the European Union's Horizon 2020 research and innovation program and Italy, Austria, Finland, Germany, Poland, Netherlands, United Kingdom.

1 Introduction and scope

With a view towards mass manufacturing of solid oxide fuel cells (SOFC) and modules, proliferation of fuel cell CHP systems and multiple stack module suppliers and system integrators, having a restricted number of fuel cell module interface designs is an important step. Thereby, it is not intended to restrict the freedom of design, neither for fuel cell stack and module nor for system developers, but rather to provide an internationally recognized set of design options to produce power generating modules that can be adopted and integrated in multiple products.
Modular build-up of power requirements as well as freedom in terms of selecting module suppliers are thus facilitated. This, in turn, should stimulate cost reductions in fuel cell module manufacturing, avoiding the need for custom designs for each system integrator, as well as lower the design threshold for system manufacturers.

With this in mind, and given the fact that a core objective of the SO-FREE project was to implement two radically different SOFC types within a unique system, the project took upon itself the additional objective (compared to call requirements) to propose a **unified stack module design that would standardize the interface between the SOFC stack and the integrating system**. This report narrates how this design solution (described in detail in Deliverables 2.3 and 3.7 of this project) has been presented to the International Electrotechnical Commission (IEC) for consideration in the future development of an international standard, or guideline, on fuel cell module design for stationary (heat and) power generation applications.

2 Generating standards: The IEC and TC105

Founded in 1906, the International Electrotechnical Commission (IEC) is the world's leading organization for the preparation and publication of international standards for all electrical, electronic and related technologies. Within the IEC, Technical Committee 105 (TC105) is concerned with fuel cell technologies, preparing international standards regarding fuel cell (FC) technologies for all FC types and various associated applications such as stationary FC power systems for distributed power generators and combined heat and power systems, FCs for transportation such as propulsion systems, range extenders, auxiliary power units, portable FC power systems, micro FC power systems, reverse operating FC power systems, and general electrochemical flow systems and processes.

Standards developed in TC105 are discussed in dedicated Working Groups consisting of appointed experts from the National Committees of the participating countries (Australia, Canada, China, Denmark, Finland, France, Germany, India, Italy, Japan, Korea, Netherlands, Norway, Russia, Spain, Sweden, Switzerland, South Africa, USA, United Kingdom, United Arab Emirates). The published documents are intended to provide objective and sound technological guidance to manufacturers, consumers, integrators and regulators on specific topics, whether related to design, testing, safety, performance criteria or environmental impact. They are never compulsory on their own and do not constitute law of themselves, but can be used or called within regulations, directives, codes or company practice to provide a benchmark for reliable and repeatable practice.

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (JU) under grant agreement No 101006667. The JU receives support from the European Union's Horizon 2020 research and innovation program and Italy, Austria, Finland, Germany, Poland, Netherlands, United Kingdom.

Within TC105 there are a number of Working Groups and Maintenance Teams that deal respectively with the development of new standards and revision of published standards.
An overview of published standards is available at the IEC - TC 105 Dashboard.

The family of standards on fuel cells developed in IEC TC105 goes by the identification number 62282. Within this class, sub-categories are defined related to application: 62282-2-xxx are standards on fuel cell modules, 62282-3-xxx are on stationary fuel cell systems, 62282-4-xxx are on fuel cell power systems for propulsion and auxiliary power units, 62282-5-xxx are on portable fuel cell systems, 62282-7-xxx are on test methods, 62282-8-xxx are on reversible fuel cells, etc.
In this way it is easier to identify the standard of interest. Standards are then purchased from the IEC for their use in the specific context (e.g. internal testing, benchmarking, certification).

3 The SO-FREE proposal to IEC TC105

To promote the adoption of a standardized stack module interface within the fuel cell system manufacturing community, a process has been initiated within IEC TC105 to generate international backing and subsequent detailed development of a technical guideline to aid manufacturers in producing easy-to-install fuel cell modules for stationary system integrators. Since 2025, following an initiative of the Italian National Committee (chaired by Kiwa, partner in the SO-FREE project, with participation of ENEA) an Ad-hoc Group (AhG18) has been set up tasked with looking into the feasibility of standardizing SOFC module interfaces for stationary applications. The first three meetings have taken place, and the participating countries (Japan, South Corea, Germany, France, Italy, Canada) are in the process of assessing support from their national manufacturers to pursue this exercise, based on the input of the SO-FREE project. If this support is obtained, the Ad-hoc Group will convert to a Working Group and start activities for a Technical Specification under class 62282-2-xxx. If this proves successful, the first preliminary draft for commenting should be ready by end of 2026.

In Figure 1, the red box represents the limits of the fuel cell module and the interfaces with the rest of the system, which is the subject of the proposed standardisation.

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (JU) under grant agreement No 101006667. The JU receives support from the European Union's Horizon 2020 research and innovation program and Italy, Austria, Finland, Germany, Poland, Netherlands, United Kingdom.

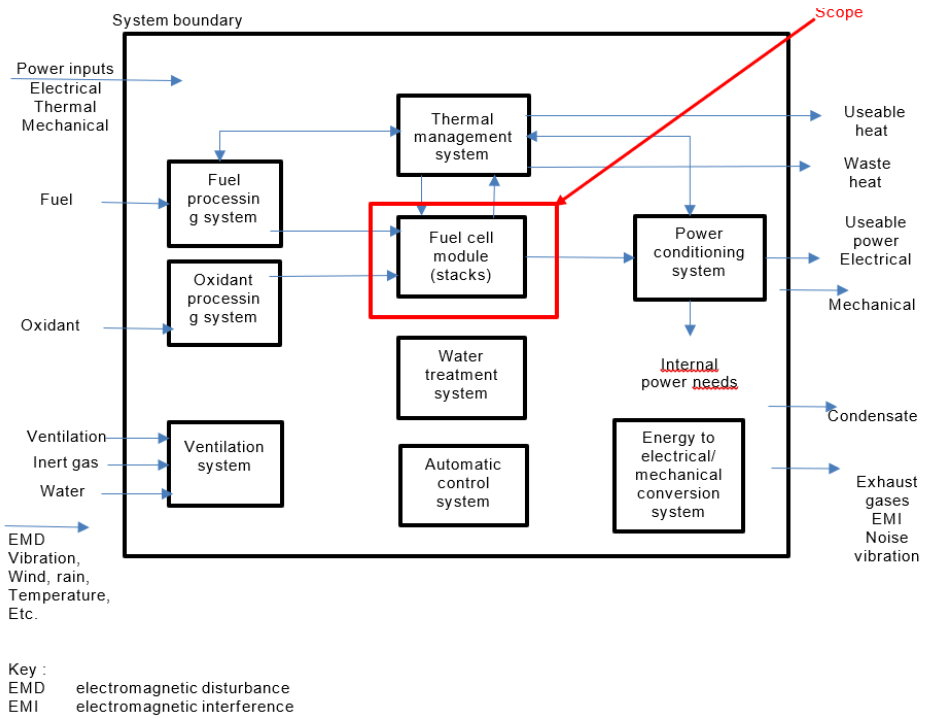

Figure 1: Fuel cell power system and interface with the Fuel Cell module containing the stack(s)

In the preliminary Ad-hoc Group phase, some of the points of discussion raised were:

- Include SOFC and PEM fuel cells or restrict to high-temperature fuel cell;
- Establish a minimum power class (e.g. >30 kWe) for the modules;
- Restrict applications;
- Define geometry sizes or only connection types;
- Define communication protocols for module control;
- Provide recommendations on interface materials and components to be used.

Also considering the wide variety of SOFC stack geometries and configurations proposed by the different manufacturers in the world, it is clear that coming to an agreement on the above topics is an arduous task. It is therefore important to stress that the design guideline shall be optional, not compulsory, and aims only to provide a previously agreed set of design requirements and options that both the stack manufacturer and the system integrator can refer to in order to speed up the design process and reduce manufacturing cost.

4 Alignment with other projects and outlook

The SO-FREE initiative for SOFC module standardization is aligned also with the Clean Hydrogen Partnership project STASHH (Grant Agreement 101005934, https://www.stashh.eu/), which developed a standardized PEM fuel cell module for integration in heavy-duty vehicles. That project focused exclusively on this outcome, thus their proposal for standardization has already acquired working group status

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (JU) under grant agreement No 101006667. The JU receives support from the European Union's Horizon 2020 research and innovation program and Italy, Austria, Finland, Germany, Poland, Netherlands, United Kingdom.

(WG110 in IEC TC 105) and a preliminary draft of the standard (targeted to be a Technical Specification with number 62282-2-401) is already under discussion. Kiwa is participating in this WG110 to ensure that AhG18 is aligned with developments in this process and to transfer decisions related to transport applications to comparable clauses for stationary applications.

Progress on these projects can be monitored at the following IEC websites:

- WG110 (PEMFC module standardization): https://www.iec.ch/dyn/www/f?p=103:38:201396709004634:::FSP_ORG_ID,FSP_APEX_PAGE,FSP_PROJECT_ID:1309,262,127752
- AhG18 (SOFC module standardization): https://www.iec.ch/dyn/www/f?p=103:14:201396709004634:::FSP_ORG_ID,FSP_LANG_ID:50748,25

Through the above initiatives it is aimed to increase the influence of European-made design within the international market of fuel cells and showcase the technological capabilities as well as the spirit of collaboration and facilitation that are natural to European initiative.

5 Conclusion

The SO-FREE project contributed to the advancement of standardization activities related to SOFC stack-module integration by proposing a harmonized stack-system interface concept within IEC TC105. The initiative represents an important step toward increased interoperability, modularity and manufacturability of future fuel cell systems.

The establishment of AhG18 and the ongoing discussions among international stakeholders demonstrate the growing interest in developing shared interface guidelines for stationary fuel cell applications. Although significant technical and industrial challenges remain, the activities initiated within SO-FREE provide a concrete foundation for future Technical Specifications under the IEC 62282 framework.

The project therefore contributes not only to technological development and system demonstration, but also to the longer-term industrialization and market deployment of modular SOFC systems.

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (JU) under grant agreement No 101006667. The JU receives support from the European Union's Horizon 2020 research and innovation program and Italy, Austria, Finland, Germany, Poland, Netherlands, United Kingdom.