FLHYSAFE

FUEL CELL HYDROGEN SYSTEM FOR AIRCRAFT EMERGENCY OPERATION

Project ID	779576
PRR 2024	Pillar 3 – H_2 end uses: transport
Call topic	FCH-01-1-2017: Development of fuel cell system technologies for achieving competitive solutions for aeronautical applications
Project total costs	EUR 7 296 552.51
FCH JU max. contribution	EUR 5 063 023.00
Project start - end	1.1.2018–30.6.2023
Coordinator	Safran Power Units, France
Beneficiaries	Arttic, Commissariat à l'Énergie Atomique et aux Énergies Alternatives, Deutsches Zentrum für Luft- und Raumfahrt EV, Instituto Nacional de Técnica Aeroespacial Esteban Terradas, Safran Aerotechnics, Universität Ulm

https://www.flhysafe.eu/

PROJECT AND GENERAL OBJECTIVES

In the shift towards more electric aircraft, fuel cell systems are considered one of the best options for efficient power generation.

The main objective of Flhysafe was to demonstrate that a cost-efficient modular fuel cell system can replace the most critical safety systems and can be used as an emergency power unit aboard a commercial aeroplane, providing enhanced safety functions. In addition, the project had the objective of virtually demonstrating that the system can be integrated, respecting both installation volumes and maintenance constraints, into current aircraft designs.

PROGRESS AND MAIN ACHIEVEMENTS

- The short stack was validated by H_2/O_2 tests.
- A critical design review of the low-temperature module for the fuel cell system was performed (and theoretical air conditioning system specifications were produced).
- A critical review of the design of major subsystems of the demonstration system was performed.
- The first module campaign test was performed
- The final demonstration system was assembled
- Operational and environmental tests of the Flhysafe demonstration system were carried out.
- The use of fuel cell technology in an emergency power unit was found to be very challenging.
- Regulations are not mature enough.
- As regulations have not yet been issued by authorities, there is still a chance that the architecture proposed in Flhysafe may need to be adapted in the future. Safran and the Spanish National Institute for Aerospace Technology are taking part in discussions through working group 80 of Eurocae.
- Fuel cell system components are not yet ready for aeronautical use and need more specific studies and development.
- The technology is not mature enough for aeronautical needs.
- The applications of low-temperature proton exchange membranes for ground-based automotive applications are well understood, but the membranes cannot be applied to aeronautical systems without further research and design efforts.
- Ram air turbines have been established by major players as offering a reliable technology for aircraft. Other options, such as fuel cells, could be considered only for new hydrogen-powered aircraft.
- However, Flhysafe has contributed to a better understanding of fuel cell technology in various domains.
  - The French industrial supply chain is increasing its maturity in manufacturing some fuel cell stack parts (metallic bipolar plates and seals).
  - One patent is in progress (co-ownership between Safran and Sealicone).
  - Understanding of O_2 use in aeronautics is improving.
  - Safety analysis is improving (through the collaboration of Deutsches Zentrum für Luft- und Raumfahrt and Safran).
  - Smart solutions are needed to tackle integration challenges, and the CEA has developed an interesting option with its direct current–direct current system.

FUTURE STEPS AND PLANS

The project has finished.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?
Project's own objectives	Weight of EPU	kg	150	220	⚙
	System power density	W/kg	100	78	⚙
	Nominal continuous electrical power	kW	18.1	18.1	✓

Clean Hydrogen Partnership
Co-funded by the European Union