

Fuel Cells for Aircraft Application

K. A. Friedrich, German Aerospace Center (DLR), Stuttgart / Germany

Although air transport is responsible for only about 2 % of all anthropogenic CO₂ emissions, the rapidly increasing volume of air traffic leads to a general concern about the environmental impact of aircrafts. Future aircraft generations have to face enhanced requirements concerning productivity, environmental compatibility and higher operational availability, thus effecting technical, operational and economical aspects of in-flight and on-ground power generation systems. Today's development in aircraft architecture undergoes a trend to a "more electric aircraft" which is characterised by a higher proportion of electrical systems substituting hydraulically or pneumatically driven components, and, thus, increasing the amount of electrical power. Fuel cell systems in this context represent a promising solution regarding the enhancement of the energy efficiency for both cruise and ground operations.

For several years the Institute of Technical Thermodynamics of the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt, DLR) in Stuttgart is engaged in the development of fuel cell systems for aircraft applications. The activities of DLR focus on:

- Identification of fuel cell applications in aircraft in which the properties of fuel cell systems, namely high electric efficiency, low emissions and silent operation, are capitalized for the airplane application.
- Design and modeling of possible system designs.
- Experimental investigations regarding specific aircraft relevant operating conditions,
- Qualification of airworthy fuel cell systems.
- Set up and full scale testing of fuel cell systems for application in research aircraft.

In cooperation with Airbus several fuel cell applications within the aircraft for both ground and cruise operation could be identified. In consequence fuel cell systems capable to support or even replace existing systems were derived. In this context, kerosene tank inertization and electrical cabin power supply including water regeneration represent the most promising application fields. The contribution will present the state of development discussing the following points:

- Modeling of different system architectures and evaluation of promising fuel cell technologies (PEFC vs. SOFC).
- Experimental evaluation of fuel cell systems under relevant conditions (low-pressure, vibrations, reformat operation, etc.).
- Fuel cell system demonstrator Hyfish (hydrogen powered model aircraft)
- Fuel cell test in DLR's research aircraft ATRA (A320) including the test of an emergency system based on hydrogen and oxygen with 20 Kilo Watts (kW) of electrical power.