Enabling more electric aircraft through quantum leaps in technology

Discover the article written by Stéphane Cueille, Safran Senior Executive Vice President, R&T and Innovation, about the more electric aircraft, published on his LinkedIn account on 2019 January, 15*. Enjoy the reading!

The concept of more electric aircraft has been around for a while now... so long in fact that we are almost beginning to believe that all-electric planes are just around the corner. But while more electric aircraft are very much a reality, and we have seen a constant stream of key innovations and spectacular advances, we still have a long road to travel before an all-electric commercial aircraft takes flight. Along the way we can expect to see some fascinating quantum leaps in technology.

Thierry Mamberti / Safran

While air traffic only accounts for 2% of the world's CO2 emissions, the industry seeks to continuously reduce its environmental footprint. The International Civil Aviation Organization (ICAO) has set an objective of becoming carbon neutral as from 2020, then reducing carbon emissions by 50% in 2050, versus a 2005 baseline – all despite the sustained growth in air traffic. It seems increasingly obvious that we need to further improve aircraft and engine architectures, but this alone won't be enough to meet these ambitious objectives. That explains our increasing interest in electrification, which will of course reduce our dependency on fossil fuels.

But what exactly are we going to electrify?

An airplane consumes energy in two ways:

- Propulsion, of course, with jet fuel for the engines,
- Non-propulsive functions (pressurization, deicing, engine starting, flight controls, actuation of the landing gear, etc.), mainly using mechanical, hydraulic and pneumatic energy sources. All of these systems can be electrified, but to varying degrees and by resolving more or less daunting technological challenges.

The first path explored from this standpoint was the electrification of non-propulsive functions. Safran is a pioneer in this field, since it developed the first electrical actuation system for thrust reversers about ten years ago. Other aircraft systems followed, including brakes, landing gear, flight controls, etc. In addition, other kinds of equipment evolved in this sense, such as the eAPU, the new auxiliary power unit from Safran Power Units, designed to meet the requirements of new generations of airplanes, helicopters and drones with more or all-electric architectures.

We are gradually expanding our portfolio of electrical systems and equipment to support the changeover towards more and more electric airplanes and helicopters. Take for instance the electric taxiing system being developed by Safran and Airbus. It should soon allow Airbus A320 family twinjets to taxi without having to start their jet engines. Meanwhile, we are working on fuel cells, which generate electrical power from hydrogen, and will help us meet some of the power needs of more electric aircraft.

Concerning electric propulsion, we have to be realistic. In the short and medium term, given the current state-of-the-art, all-electric propulsion just isn't feasible for large commercial airplanes, because the batteries and wiring would be too heavy.

Hybrid propulsion systems

That leads us to a second option, a hybrid propulsion system, meaning partially electric. Of course, several companies are already striving to develop this kind of aircraft, in particular Airbus, with their E-Fan X regional demonstrator, and the startup Zunum Aero, supported by Boeing, which is focusing on 6 to 12-seat aircraft.

A more targeted market is also emerging, namely vertical takeoff and landing (VTOL) or short takeoff and landing (STOL) aircraft. These aircraft are typically designed for urban and suburban transport of a limited number of passengers, either two to four for air taxis, or a dozen for inter-city routes. Safran is a pioneer here, as reflected in our partnership with Bell concerning the propulsion system for their planned air taxi. Slated to enter service next decade, the project has Safran Electrical & Power and Safran Helicopter Engines teaming up to develop an Hybrid Electric Propulsion System.

The first application for this system, the Nexus, was officially introduced by Bell at the Consumer Electronics Show (CES) in Las
Vegas on January 7, 2019. This marked a milestone for the sector and also for a partnership that will allow us to quickly move up the skills chain in hybrid propulsion systems and become a market leader towards 2025.

Going forward, our work is guided by several objectives. First, enhancing our expertise in electrical power generation, especially via turbo-generators. Along with our in-house R&D, we have taken a stake in Turbotech. This start-up is developing an innovative thermal energy recovery solution to increase turbomachinery efficiency. The first application of this technology will be on a turboprop engine for general aviation applications. We are also working on wiring and connectors that can handle strong currents to improve energy distribution systems. The addition of Zodiac Aerospace to Safran gives us a strategic advantage, because we now offer proven skills in all aspects of electrical distribution.

These advances naturally have to be developed in partnership with all stakeholders, from industry of course, but also with regulatory authorities, because certifying these hybrid propulsion systems is an absolute prerequisite for their market introduction. While all-electric aircraft have yet to become a reality, electrification is moving forward at a fast pace, and is even affecting the propulsion function because of hybridization.

Perhaps with just two or three more technological breakthroughs, we will be seeing the first all-electric commercial airplane. Each major advance will boost performance, especially for the environment, and pave the way for a major disruption in the future of aviation.

*You can find it on his Linkedin account*