#14 - ArctEvac

Antarctica is home to a host of research bases, of which the most remote is the Amundsen-Scott South Pole research base. During the polar winter, there are no flights to Amundsen-Scott due to extreme weather conditions. In the 65 years that the research base has been active, workers have been evacuated in winter due to medical emergencies on three occasions. The preparation time required for these missions with current technology has meant people with serious medical needs had to wait for weeks to get help. It is, therefore, important to create a solution with modern technology to facilitate quick medical evacuation of people from the South Pole.

Mission Objective

ArctEvac is an aerial medical evacuation mission between the remote Antarctic research stations of Rothera and Amundsen-Scott. The aircraft can fly 2500 km in a single leg with net zero CO_2 emissions, and perform medical evacuation missions with a 95% chance of being able to fly in the harsh Antarctic winter weather conditions. Extreme wind gusts, a minimum temperature of -82°C, whiteout conditions, total darkness and short ice runways do not allow most aircraft to even attempt this mission. Designing an aircraft to perform in these extreme conditions allowed the group to fulfill the project objective statement of obtaining a better understanding of the design cycle of an aerospace system by producing a design that fulfills the mission need statement together with a group of 10 capable aspiring engineers in 10 weeks.

System Design

The JAPA-12 is an aircraft with a distributed propulsion (DP) system. The aircraft is characterised by its hybrid-electric propulsion system, which consists of two combustion engines generating electricity for 10 electric engines in a partial turboelectric configuration. The combustion engines generate electricity and run two main propellers by burning synthetic kerosene. The DP system allows the aircraft to have Short Take-Off and Landing (STOL) characteristics as the increased airflow over the wing due to the distributed propellers raises the maximum lift coefficient. The aircraft is also safer compared to conventional aircraft as single-point failure does not result in a significant loss of thrust due to the powertrain configuration. The aircraft structure is predominantly made of aluminium 7075 and CFRP, making the aircraft more than 90% recyclable by mass at end of life. Furthermore, as the main goal of this aircraft is the treatment of a medical evacuation patient, the aircraft is equipped with standard air ambulance equipment. An additional electric circuit guarantees continuous support of the medical equipment, even in emergency conditions. The landing gear is a combination of skis and conventional wheels to allow for landings on both asphalt and ice runways.

In the final three weeks of the DSE, the details of the aircraft will be elaborated upon. This will entail finalising the analyses regarding stability, vibrations, noise generation, as well as structural loads and stresses. A detailed market analysis ensuring the design is profitable at a list price of 7.5 million will also be performed.