Group 14 - A New European Stratospheric Research Aircraft

In the context of rapid and uncontrolled climate change, demand for high-altitude atmospheric research has increased. Traditionally, research requiring little controllability was conducted using balloons, while existing stratospheric aircraft were employed for research demanding long-range capabilities and high accuracy. The current high-altitude fleet is composed of four different aircraft: the U-2, the WB-57, and the RQ-4 Global Hawk all operated by NASA as well as the M-55 Geophysica that was used by ESA to perform high-altitude research. Looking at the capabilities of the current fleet, it was found that they are not fully suited to modern scientific research due to being expensive to run and difficult to maintain, limiting researchers. Furthermore, the M-55 and RQ-4 have been retired while the U-2 and WB-57 are approaching 60 years of service and are likely to retire in the coming decade. It can thus be seen that a market gap for high-altitude research aircraft is opening up. The European Stratospheric Research Aircraft (ESRA) will be aimed at filling this gap.

Mission Objective

Given the relatively low budget given to scientific missions, minimizing cost was one of the driving goals of the design of ESRA. The cost constraint as well as the target of 2030 for entry into service heavily influenced the design choices made throughout the project. Technical requirements were derived from discussions held by an external adviser, Wake Smith, with scientists involved with high-altitude research. It was found that an aircraft with a payload capacity of 100 kg and a minimum service ceiling of 20.5 km was desirable for scientific research. Furthermore, it was found that a range of 6000 km would be required in addition to the capability to loiter for up to one hour on the station. These requirements served as a starting point for the complex design of a very high-performance aircraft.

System Design

In the process of designing ESRA, multiple options, including, blimps and unmanned propeller aircraft, were considered. In the end, the concept of a manned, jet-powered aircraft was selected for full development. With the concept selected, a decision had to be made regarding the overall aircraft layout. After some investigation, it was decided to use two-wing podded jet engines and design the aircraft around them. Focus was given to specific points of the design of the project. Indeed, the payload by designing trolleys with see-through bottoms which can then be mounted into the aircraft. A pressurized version of the payload pallet was also designed for more sensitive instruments as well as a pallet capable of dropping sondes was designed in order to provide data about a complete weather column. Attention was given to the wing structure and engine characterization at different altitudes. Cost estimations were also made for the acquisition and direct operating costs to provide potential clients with an idea of the costs and incomes associated with the acquisition and operation of ESRA.