



INVENTING THE FUTURE

DATASHEET 7 – 2006 to 2012

VIRTUAL FLIGHTS



Virtual Flight 2007



Virtual Flight 2007



Bertrand Piccard – Virtual Flight 2008



André Borschberg – Virtual Flight 2008

Simulations for the mission team

While the engineering teams worked on building the HB-SIA prototype, the Mission team specialists focused on preparing the flights. To predict the behavior of the future aircraft, and to calculate the flight paths best suited to its characteristics, it was vital to simulate a real flight. This simulation is done using highly complex algorithms, incorporating a very large number of parameters.

2005 and 2006 simulations

Several simulations were conducted in 2005 and 2006, while the aircraft was in the design phase. They served to validate the planned configuration, like the wing surface and the battery weight. Similarly, the flight profile, in particular maximum altitude and the duration of a night flight, was fine-tuned. Finally, the team of meteorologists was able to assess its own ability to produce reliable models.

2007 Virtual Flight

In May 2007, using software developed in partnership with engineers from Altran, Solar Impulse made a virtual flight corresponding to one of the five legs of flight around the world, between Hawaii and Florida. Just as for a real flight, team members were mobilized during 24 hours around the computer to analyze weather conditions and update the aircraft's flight path accordingly. In fact, the main challenge facing the mission team is to keep the aircraft in cloud-free skies so as to capture the maximum amount of solar energy.

2008 Virtual flight

A year later, in April 2008, Solar Impulse undertook a virtual flight using a completely new simulator. Designed with Dassault and EPFL, this simulator includes a cockpit identical to that of the prototype, with a volume of 1.3 m³ and all flight instruments. Arranged 210° around the cockpit, five screens provided a panoramic view of the earth and sky. Equipped and harnessed as in a real flight, with food reserves and accessories designed to satisfy their natural needs, Bertrand Piccard and André Borschberg succeeded each other



Flight Simulator



Medical check before simulation – Virtual Flight 2012



Medical check – Virtual Flight 2012



Trying to get some sleep – Virtual Flight 2012



Yoga exercises – Virtual Flight 2012

at the commands. In constant contact with the Mission team, they each made a 25-hour virtual flight. Each maneuver, from take-off to landing was simulated on the screen including the lighting variations from daylight to night with the spectacle of lit-up cities and the appearance of dawn. At the controls, the feeling of reality was so strong that Bertrand Piccard summed up the experience by saying: "I climbed into a simulator and I climbed out of an airplane."

This virtual flight allowed pilots to test their adaptability and resistance. Maintaining sufficient concentration over such a long period, while remaining almost motionless in such a small space, requires special preparation. Bertrand Piccard and André Borschberg are both monitored by Dr. Jean-Pierre Boss of the Hirslanden Medical Group, a partner in the Solar Impulse project.

For this simulation, the pilots wore sensors attached to their skin, which measured several physiological factors like heart and respiration rates and body temperature. Fatigue management is not the least of the challenges of such an experience for the pilots. They had to learn to rest while continuing to pilot the aircraft and each pilot experimented in his own way: self-hypnosis for Bertrand Piccard, yoga for André Borschberg. When flying conditions permitted, they allowed themselves 10-15 minute naps. A vibrator sleeve connected to the Omega Instrument was there to alert them of any excessive tilting of the plane. This device is part of the human-machine interface developed by EPFL to assist the pilot during flight.

In this virtual flight, pilots also familiarized themselves with the flight envelope that is the overall behavior and limitations of the aircraft. HB-SIA's aerodynamic characteristics and the uniqueness of functioning on solar energy make it an exceptional aircraft. The pilot needs to monitor the production, consumption and storage of energy. At daybreak, as soon as the sunlight is strong enough, the aircraft can gain altitude. HB-SIA's operating ceiling is at 8500 m. At this altitude, the more intense solar radiation ensures optimal operation of the photovoltaic generator. During the night, the pilot descends gradually to 1500 m. At low altitude, the air is denser, and the plane needs less energy to fly. The engine can then run on the electricity stored in the batteries.

2012 Virtual flight

On 20 February 2012, the first virtual flight in HB-SIB's cockpit took place for the duration of 72 hours. The objective of the flight was to simulate a long-distance leg, with changing meteorological conditions and potential obstacles along the way that André Borschberg and Bertrand Piccard will most likely face during the flight around the world. But what was most important was to test the life of the pilot during three days and



Virtual Flight 2012

three nights inside the cockpit. Given the high level of concentration required to fly the solar aircraft coupled with the length of the flight in the cockpit's confined space, health and nutrition specialists as well as the Solar Impulse team had to study every minute detail of the pilot's behavior. They studied that pilot's reactivity, sleeping patterns and ability to maneuver the aircraft as well as technical aspects such as the pilot's seat ergonomics, accessibility the aircraft's controls and overall comfort.