

INFORMATION

Turin 26.5.2010

The first European Commission funded Aircraft powered by a Hydrogen Fuel Cell took its first flight.

RAPID 200-Fuel Cell, first aeroplane in Europe and in the World fuelled by hydrogen, funded by European Commission and coordinated by Prof. Romeo of Politecnico di Torino, successfully concluded flight tests.

The speed and endurance world records were established for Electrically-powered Aeroplane (Class C) Fuel Cells operated (ZERO EMISSION).

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At 07:14 UTC on 20th May 2010, European Commission research project Rapid200FC, hydrogen fuel cell powered aircraft, took its 2 minutes maiden flight in Reggio Emilia, Italy. The first aero-mechanical flight was followed by a 11 minutes flight envelope investigation flight.

The completely electrical power system was successfully tested during the experimental flight. The rotation speed of 84 km/h has been obtained within 184 m of taxi at power of 35 kW. After take-off, speed was then increased up to indicated values of 110-120 km/h. Level flight at 700ft and 130 km/h was attained by mean of only fuel cell power setting.

Positive handling qualities and satisfactory engine performances of these two flight tests let the team to consider this successful early flight as good starting point for the long endurance high speed flights.

On 26th May 2010, a new speed world record of 135 km/h (flown of 4 consecutive runs over a 3 km course - according to FAI Sporting Code, Class C Aeroplanes) was established. Also several higher speed at 145-150 Km/h for tens of seconds were measured during free flights. The flights, fuelled by Air Product by gaseous hydrogen at 350 bar pressure, reached an endurance of 40-45 minutes.

The previous record was established by Boeing Research & Technology Centre (Madrid) in their world first hydrogen flight (120 km/h for 20 minutes with a motor-glider, Class D, FAI Sporting Code); also DLR flew in 2009 with a motor-glider (Class D, FAI Sporting Code) powered by fuel cells.

The results obtained during flights can be considered as a further step in the European and World Aeronautics Science in introducing a completely clean energy (ZERO EMISSION).

The successfully results was possible thanks to the excellent work performed by the young researchers involved in the project (among the others Gabriel Correa, Fabio Borello, Marco Pacino, Denny Chiono, Gianni Maffi, Alex Orsillo, etc.) and by the ability of the experimental test pilot Marco Locatelli.

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Rapid 200-FC – 1st-2nd Flight tests



Rapid 200-FC – 3rd Flight test

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Rapid 200-FC – 4th Flight test

The aircraft has an entirely electric 40 kW propeller: power is supplied to the propeller through 20 kW hydrogen gas fuel cells. In order to guarantee absolute safety of the operations, the aeroplane also has a second source of energy that consists of a set of 20 kW lithium polymer batteries which are able to guarantee alternative or supplementary power during take off and initial climbing.

The electric engine is fed through the generation of high energy currents in an ionization and hydrogen re-combination system (PEM) which has a final product of 100-110 Amps of electrical current at 200-240 V, plus air and water vapours emitted at environmental temperature.

Fuel cell stacks (completely developed by Intelligent Energy) give their power at 65°C; the cooling water is circulating within the transparent plastic tube, placed in the cabin, that supply the fuel cell system from the water tank placed in the right wing.

The aircraft and the electric and energy system have been developed, according to a design by Professor Romeo, and tuned by the team which consists of the 10 companies and enterprises involved in the European Community “**ENFICA-FC**” project (**Environmentally Friendly Inter City Aircraft powered by Fuel Cells**) coordinated by Professor Giulio Romeo of the Department of Aerospace Engineering at the Politecnico di Torino. (<http://www.enfica-fc.polito.it/>).

The ENFICA-FC project was chosen by the aeronautical and space planning committee from among hundreds of other programmes presented. The overall cost of the project is 4.5 million Euros of which 2.9 million Euros is financed, for the first time in Europe, with public funds allocated by the European Commission.

The team is made up of the Politecnico di Torino (IT) (Design of the modified aircraft and experimental test flights), Skyleader (CZ) (constructor of the aircraft), Intelligent Energy (UK) (designer and constructor of the hydrogen fuel cells), APL (UK) (in charge of the tanks and supply of the high pressure hydrogen), Mavel Elettronica (IT) (designer and constructor of the inverter and electronic control of the power) and the University of Pisa (IT) (design engine case and preliminary lab. tests on the electric system).



The reliable and sophisticated fuel cell system was specifically built by Intelligent Energy to guarantee the supply of the 20 kW of power necessary for take off and cruise flight.

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The exceptional and sophisticated power electronics system was specifically developed and manufactured by Mavel to guarantee the supply of the 40 kW of power necessary for take off while satisfying the difficult requirement of limiting weights (less than 15 kg) and encumbrance so that it could be installed on the airplane.

Summarising, Romeo says that "... the objective is that of building an aeroplane that works on hydrogen, taking advantage of the "fuel cell" technology at present available to create a demonstrator aircraft that is able to connect cities through flights while totally eliminating the environmental impact (**ZERO CO2**). The work plan financed by the EC is divided into two stages: modification of a light-weight two-seater airplane with an electric engine completely supplied by hydrogen; the test flights on this are aimed at identifying the technical advantages and improvements in performance obtained with the new generation electrical energy.

Commander Marco Locatelli, to whom the test flights have been entrusted, has underlined that a maximum velocity of 150 km/h has been reached, that the maximum internal temperatures of the electric system do not reach 70° C at maximum power and that the only fluid in the fuel cell supply circuit are the 8 litres of bi-distilled water contained in the tank on the right wing.

The ENF  CA^{FC}  project, which began in 2006, finished positively with the final test flights in the months of May 2010; for this reason, the Politecnico di Torino research group, headed by Professor Romeo (Engineers Fabio Borrello, Gabriel Correa and Marco Pacino), has been offered hospitality at the Reggio Emilia airport.

The starting up, functioning under power and taxiing tests of the aircraft with its definitive propeller have been carried out along the 1400 metre runway at the Reggio Emilia airport. The first high speed taxiing tests (120 km/h) were successfully carried out on the *Rapid 200-FC* "zero emission" aircraft between December 2009 and February 2010.

The hydrogen at high pressure (350 bar) (supplied by Air Product), the 20 kW LiPo battery set and the electric engine have proved to be reliable and offer continuity of supply of the more than 40 kW power necessary for take off. The sophisticated electronic control system ensures redundancy and makes both sources of energy available to the pilot in order to guarantee the safe functioning of the single propeller, even in the case of breakdown of the hydrogen current generators.

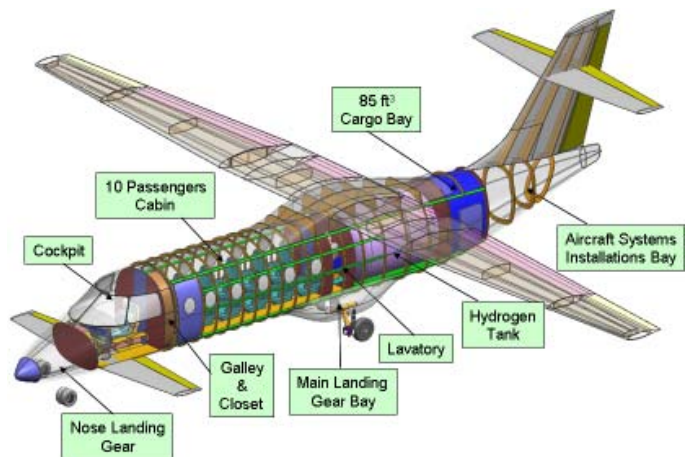


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The airplane (whose final lay-out was achieved with the technical assistance of the Italian Skyleader importer – T&T Ultralight) has a wing span of about 10 metres and total weight of 550kg (850 kg was the total weight of the Boeing project). With the systems at present available, the airplane has autonomy of about 1 hour and can reach a cruising speed of 150-160 km/h, thanks to the hydrogen alone.

Among the advantages of an aircraft of this type, mention can be made of its remarkable silence: a characteristic that can greatly improve the quality of life around city airports.

At the same time, more theoretical type studies have been carried out (in collaboration by the Israel Aerospace Industry, Université Libre de Bruxelles and Evektor (CZ) partners). These will not have an immediate practical application in the initial stages because of the present technological limits, but have the aim of using zero emission propellers in the future to equip aircraft for 20-30 passengers in the regional and intercity sector”.



Intercity Fuel cell powered aircraft (by Israel Aerospace Industries)



Rapid 200-FC – Aircraft breaking test

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Rapid 200-FC – 1st Taxiing test



Rapid 200-FC – 1st Taxiing test at take off speed



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