**RETAX**

Efficient solution for Rotorcraft Electrical TAXiing on ground, without rotor spinning.

### Context

In the view of meeting the ACARE goals and radically reducing the impact of air transport on the environment, one concept being investigated is to move towards electrical aircraft.

Innovative solutions and breakthrough technologies will have to demonstrate overall increase of efficiency and reduction of undesirable emissions.

#### E-Taxiing for helicopter

The concept being investigated by the project partners is to use electric taxiing as an alternative method of maneuvering rotorcraft on ground, without any spinning of the rotor.

Rotorcraft needs to maneuver from the hangar to the loading zone and then to the take-off zone. A typical day for a helicopter includes 5.6 km taxiing between the various zones (3 flights cycles).

### Goal

The goal of RETAX is to explore intrinsically safe and efficient solutions for rotorcraft autonomous taxing on ground. It will minimize noise, emission and overall weight of the system, extend autonomy and increase safety on the airport. It will be based on electrically-powered motorized wheel, integrated within the landing gear. Subsequently the most promising solution will be developed into a technical demonstrator to be tested.

### Deadline

The RETAX project started in November 2011 and was completed in December 2013.

### Trend

The current trend to evolve towards electrically controlled and actuated aircraft is an ongoing process. These electric systems are lighter, thus enabling to achieve significant savings in fuel consumption.

On-board electrical systems are very common in the entire airplane. Electrical taxiing is just another electrifiable function; electrical braking and electrical flying control are other examples.

Electric taxiing is an alternative method of maneuvering rotorcraft on ground, without any spinning from the rotor.

### Motivation

The main advantages identified consist of:

- Reducing fuel consumption during taxiing, using an efficient motion system
- Suppressing noise on ground generated by the high speed turning rotor
- Improving ground personnel safety by suppressing main and tail rotor rotation
- Allowing autonomous on ground movement, even backward without external means

### Specific challenges

This technology is based on an electrically-powered motorized wheel integrated within the landing gear, relying on an electrical energy source.

Even if it does already exist for automotive application, or is being investigated through research project for aircraft, no demonstrator for helicopter taxiing has been produced until now.

Even if aircraft and rotorcraft seem to be quite similar for taxing use, there are specific challenges for rotorcraft:

- Horizontal take off speed could be more than 300 km/h for aircraft, and zero for rotorcraft
- The actual taxiing cycle is not well known for rotorcraft as for aircraft
- For commercial aircraft the trips are planned and taxiing phase well known. For helicopter trips this is not the case, typical use cycles have to be defined.
- Safety issues are different and this could lead to different solutions.
- For rotorcraft there is tighter weight constraint due to the lower absolute mass and the higher sensitivity

Description of work
The RETAX study has been divided into three phases:
- Preliminary study, to complete the set of sizing requirements, analyse ground taxiing cycles and propose a selection of possible technical concepts and architecture. The most suitable solution has been selected during the Preliminary Design Review (PDR), based on a matrix presentation.
- Detailed analysis of technology implementation and performance of the intended solution, and modelling of components. The global system has been detailed, tuning precisely the final solution in order to reach the best compromise.
- Manufacturing the demonstrator developed in the precedent phase. After the test of the individual components, the complete system has been assembled and tested in order to demonstrate the intended performance and the fulfilment of the requirement. An extrapolation study has been conducted for a different size of rotorcraft (6 tons versus 12 tons).
- In parallel to these three tasks, the preliminary figures of the exploitation approach and impact analysis have been carried out, in order to assess the business case for the solution.

Tests
Based on Airbus Helicopters specifications for heavy rotorcraft, all the tests below have been successfully passed:
- Performance
- Electric Power Supply
- Taxiing and maneuver environmental
- Safety and Integrity

Results
The RETAX solution has been analysed and tested in details with promising results in terms of performance achievement and safety features. RETAX demonstrator proves the technical viability and effectiveness of such electrically driven rotorcraft ground taxiing.

A Technology Readiness Level 4 has been reached.
- The global system for the heavy rotorcraft represents a net weight reduction of 35kg for the foreseen cycle: added weight around 45kg and fuel saving around 80kg.
- The fuel saving will represent 240kg of fuel per day (3 cycles), or around 62 tons/year/rotorcraft
- The CO2 equivalent savings represents around 196 tons/year/rotorcraft
- Furthermore, the RETAX solution enables to keep the rotor stopped during taxiing which significantly improves the safety and reduce the noise related to this operation.

Environmental benefits
In the overall picture of CO2 emission sources, helicopters represent a minor part of the total transport related emission. Nevertheless, policies are developed which put pressure on CO2 emissions, and electric taxiing is considered as a viable answer.

The reduction of noise proves to be another environmental benefit, thanks to the limited engine power used for taxiing, and the not turning rotor which produced most of the noise emitted.

The reduction of noise during ground maneuvering is not only relevant for those who live near heliports; it is also identified as a great benefit for those who work on these heliports.

Maturity of works performed
The former experience of Michelin in electric-drive solutions for motorized cars, busses and aircraft will be used and translated into rotorcraft electric taxiing system. A high level of integration and performance will have to be reached in order to achieve an optimal solution.

This feasibility demonstration of electrically driven rotorcraft ground taxiing in accordance with Clean Sky electrification objectives will be a significant step towards greener rotorcraft operations, bringing this technology closer to the market.
**View of the tests:**

**Face to face test bench**

![Image of face to face test bench]

**Dyno test**

![Image of Dyno test]

**View of system:**

![Image of system]
Project Summary

Acronym: RETAX
Name of proposal: Rotorcraft Electric Taxiing
Technical domain: EMA for utility consumer systems: EMA for Landing Gear
Involved ITD: Green Rotorcraft
Grant Agreement: 296482
Instrument: Clean Sky
Total Cost: 945378€
Clean Sky contribution: 472689€
Call: SP1-JTI-CS-2011-01-GRC-03-06
Starting date: December 2011
Ending date: December 2013
Duration: 25 months
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