The European Tilt Rotor Status of ERICA Design and Test Activities

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NICETRIP Project Manager

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Aerodays 2011
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Handling Qualities requirements background

Flight Control System Level 1 Control Laws

Rotor Hub Design

Low Speed Aerodynamic Interactions

Proprotor Gearbox, Interconnecting Shaft, Nacelle & Wing Actuators Loads & Dynamics

Rotor Dynamics, Performance & Noise

NICETRIP
ERIKA DESIGN CONCEPT

Small Rotor Diameter

Tiltable Wing

Structural Continuity of Tilting Mechanism

TILT WING

TILT ROTOR

TOW 11 tons
Pax 19/22
Vmax cr 330 Kts
The NICETRIP Integrated Project is proposed as part of a continuing European \textit{TILTROTOR} programme aimed at the acquisition, validation and integration of tiltrotor technology by the European Aerospace and associated supplier industries.

The main objectives are:

- to study the \textit{general architecture} of the aircraft
- to integrate some of the critical components of a tilt rotor aircraft on \textit{full-scale dedicated rigs}
- to develop and test a \textit{full-span powered model}
- to study the introduction of the \textit{T/R in the ATM}
### NICETRIP CONSORTIUM

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NICETRIP ACTIVITIES

Tool validation

- Validation of flight mechanics tools
- Validation of CFD tools
- Validation of the aeroelastic tools

Blade flapping moment
Pressure distribution on the wing
Hub loads

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NICETRIP ACTIVITIES

Overall characteristics

• Weight estimate
• Aircraft performance
• General loads
• Handling qualities
• Noise

Maximum Speed sensitivity analysis

Design Gross Weight (VTO) @eta = 0.85, escresc=0%
maximum Gross Weight (STO) @eta = 0.85, escresc=0%
Design Gross Weight (VTO)@eta = 0.85, escresc=0%
maximum Gross Weight (STO) @eta = 0.85, escresc=0%

ISA
ISA+20°C
NICETRIP ACTIVITIES

Aerodynamics

• Rotor blade and cuff optimisation
• Wing and tail plane airfoils optimisation
• Nacelle/wing fairings optimisation
• Fuselage/wing fairings optimisation

Friction lines for the 4 blades
NICETRIP ACTIVITIES

Dynamics

• Rotor aeroelasticity
• Drive train and engine stability
• Whirl flutter stability
• Vibratory level/comfort
General architecture

- Aircraft general layout
- Systems integration
- Electronic mock up definition
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Airframe

- Wing structural preliminary design
- Fuselage structural design
NICETRIP ACTIVITIES

Power plant

- Nacelles structural design
- Drive system design
NICETRIP ACTIVITIES

- Rotor hub design
- Rotor blade design

Power plant

Cross section at 390 mm Radius

Cross section at 650 mm Radius

Cross section at 1573 mm Radius
NICETRIP ACTIVITIES

Hydraulics

- Hydraulic system requirements definition
- General architecture of the Hydraulic system
- Preliminary sizing of the hydraulic system components
NICETRIP ACTIVITIES

Fuel system

• Fuel system requirements definition
• Fuel system layout and functional specification
• Fuel system components preliminary specification
• Fuel system design baseline
Whirl tower full scale test

- Assess the dynamic behaviour
- Functional tests for rotor and transmission
- Performance tests
Drive system functional test

• Lubrication test
• Endurance and functional test in the Universal Transmission Test Facility
NICETRIP ACTIVITIES

Powered model wind tunnel test

- Powered model scale 1:5 design and manufacturing
- Tests at DNW-LLF wind tunnel
- Tests at ONERA-S1MA
Force model wind tunnel test

- Modular model scale 1:8 design and manufacturing
- Tests completed at the wind tunnel of Politecnico di Milano
NICETRIP ACTIVITIES

Air intake model wind tunnel test

• Air intake model scale 1:5 design and manufacturing
• Test completed at the wind tunnel of University of Liège
• Air intake model scale 1:2.5 design and manufacturing
• Preliminary test completed at the wind tunnel of POLIMI
• Final test at the wind tunnel of University of Liège
Real time simulation

- Several Standalone Real Time Simulation sessions performed at partners’ site to assess flyability of the procedures under investigation
- Distributed Real Time Simulation based connecting ATC simulation platform with 3 tilt-rotor simulators to evaluate the impact of tilt-rotor operations with “conventional” traffic on a complex operational airport scenario (Milan Malpensa)
- Actors involved: Pilots, ATCOs, Pseudo-pilots, Technical experts