CARE Curved Applications for Rotorcraft Environmental enhancement

State of the art – Background
Air traffic is expected to grow continuously in the next decades. Reducing the environmental footprint of aviation has therefore become a major challenge for industry stakeholders and including for rotorcraft operators. Working towards greener skies, the European Commission has created jointly with the aviation industry the Clean Sky Joint Undertaking. Its objective is to develop technologies that mitigate the impact of air transport on the environment (reduction of aircraft external noise, emissions and fuel consumption).

One of the initiatives launched by CleanSky JU in this perspective is the CARE project (Curved Applications for Rotorcraft Environmental enhancements). The project consists in developing new curved IFR (Instrument Flight Rules) procedures for rotorcraft using satellite-based augmentation systems (GNSS-SBAS).

For this two-year project CleanSky JU has selected a consortium led by Egis Avia and also formed by the French air navigation service provider (DGAC/DSNA), Pildo Consulting and CGX Aero. The consortium will provide support in the design and implementation of curved GNSS-SBAS IFR procedures for rotorcraft.

Objectives
The CARE project will provide complementary analysis related to the curved capabilities on top of the activities currently on-going in GARDEN project (GNSS-based ATM for Rotorcraft to DEcrease Noise).

GARDEN project consists in developing new IFR flight procedures based on the use of GNSS and enabling rotorcraft to reach busy airports fully independently of the airplane traffic operating from or to active runways.

CARE will permit to have a complete overview of rotorcraft specific IFR procedures relying on GNSS benefiting from curved capabilities and SBAS improved positioning.

The objectives that will be achieved in the frame of this project are to:
- Identify the regulation baseline for rotorcraft curved IFR procedures;
- Design new generic IFR SN1 low noise curved rotorcraft procedure relying on SBAS;
- Assess the benefits of SBAS guidance for curved segments in rotorcraft IFR procedures;
- Implement a Point in Space (PinS) SBAS curved approach;
- Support CleanSky JU dissemination activities.

Description of work
The CARE project is structured in five main Work Packages (WPs):
- WP1 – State of the Art: this first activity encompasses the inventory of regulations for curved segments in existing procedures as well as an analysis of the flight path protection surfaces to be used as inputs for the rest of the project.
- WP2 – Design Criteria Proposals: this work package permits the definition of low noise curved criteria and the completion of the safety analysis. Regarding the criteria, the goal is to define adapted criteria for curved segments to be used on top of current operations (RNP 0.3, RNP APCH, RNP AR) for rotorcraft IFR operations and also considering the SBAS navigation performance, the PinS concept and compatibility with the SNI concept. The safety analysis addresses the use of those curved PinS procedures. The definition of criteria is done in parallel to the safety analysis in order to ensure that defined criteria are safely applicable.
- WP3 – Benefits and Constraints: this third part of the activities is conducted in two steps with firstly the identification of the benefits brought by SBAS guidance for curved segments and then, the study of the pros and cons qualitatively and when possible quantitatively through a cost-benefit analysis on a specific case to issue a business case.
- WP4 – Procedure Implementation: this part of the activities consists in designing and implementing a specific approach procedure. This procedure is based on the new criteria defined for PinS SBAS curved procedures. The platform chosen for this specific implementation is proposed to be located in a constraining environment (such high density urban or mountainous area). The focus is made on environmental impacts particularly in terms of noise footprint.
- WP5 – Disseminations: Dissemination activities are conducted through the delivery of a synthesis of the results achieved, a User Forum organised to present and disseminate the results of the project, and finally a continuous support to CleanSky JU concerning its own dissemination activities.
Expected results
a) Timeline & main milestones
GARDEN project started in February 2013 and lasts 2 years.
Regulatory inventory related to curved segments (WP1) has been completed since 2013.
Design Criteria Proposals and safety study is ongoing (WP2): the activity related to the design of new generic IFR SNI low noise curved rotorcraft procedures relying on SBAS is completed. In parallel a safety analysis is currently being conducted related to the implementation of such procedures and will be finalised end 2014.
The first benefit assessment (WP3) has been delivered end 2013. In a second stage, a business case for curved IFR rotorcraft procedures is ongoing based on the methodology used in SESAR (Single European Sky ATM Research).
Procedure implementation (WP4) in a rich-obstacle environment such as La Seu d’Urgell in Spain started mid-2014 and is under finalisation.

b) Environmental benefits
Low noise flight operations
These new curved trajectories are of major interest as they allow rotorcraft to avoid flying over noise sensitive urban areas, especially thanks to the use of high-precision GNSS-SBAS guidance for approaches and departures. This is particularly important for Final Approach and Take-Off areas (FATOs) located within urban areas.
Low noise procedures are a major green leap forward and they increasingly capture the interest of airports and operators as an effective solution for minimising noise nuisances in populated areas overflown by rotorcraft.

Improved safety
GNSS-SBAS guidance also enhances both the precision and the performance of rotorcraft navigation. In particular, curved procedures enable rotorcraft to operate under IFR in challenging environments such as mountainous areas and to fly safely steep approaches to airports or heliports that are difficult to access or located in densely populated areas. This is particularly important for medical air transport to city hospitals or for helicopter operations in the vicinity of airports without interfering with the surrounding fixed-wing aircraft traffic (Simultaneous Non Interfering operations).

c) Maturity of works performed
At regulatory level, the analysis conducted addressed in particular the two possibilities available today to design curved procedures: the RF capability in the RNP AR operations and the RF capability in the PBN standard operations (RNP x and RNP APCH navigation specification).
In particular, design criteria have been reviewed including a comprehensive analysis of the flight path protection surfaces in the horizontal and vertical planes. Potential areas of improvement considering rotorcraft and SBAS performance have also been highlighted. Moreover, all of the above has been analysed in the light of the PBN manual in order to tackle the operational aspects.
This document also considered the applicability of the different curved segments concepts regarding rotorcraft needs and flight phases.
Moreover other concepts such as curved FAS DB (Final Approach Segment Data Block) or curved TAP DB (Terminal Area Path Data Block) have been addressed.
This document constitutes the basis for the rest of the CARE project and in particular for the drafting of design criteria.

Design criteria and associated safety study have be drafted for the RNP 0.3, RNP APCH (LPV) and RNP AR navigation specifications (thus addressing the approach phases of flight) for 3 different cases:
- Curved rotorcraft approach under full SBAS guidance with straight-in RNP AR or LPV final approach (3D);
- Curved rotorcraft approach under full SBAS guidance with curved RNP AR or LPV final approach (3D);
- Curved rotorcraft PinS approach under full SBAS guidance.
SNI operations constraints and noise minimisation are the main drivers for defining those procedures.
Project Summary

Acronym: CARE

Name of proposal: Curved Applications for Rotorcraft Environmental enhancement

Technical domain: IFR Rotorcraft Procedures

Involved ITD: Green Rotorcraft

Grant Agreement: 325995

Instrument: Clean Sky

Total Cost: 549,913.20 €

Clean Sky contribution: 342,855.00 €

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