Clean Sky 2
Call for Core Partners Wave 04

Fast Rotorcraft IADP - NextGenCTR

www.cleansky.eu

Clean Sky 2

CS2 Fast Rotorcraft NGCTR Objectives

The main objectives for the Clean Sky 2 NextGenCTR Programme (Next Generation Civil Tiltrotor - NGCTR) are the following:

- Validation of **key tiltrotor technologies** for rotors, drivetrain, wing, empennage, engine installation and Flight Control System (FCS)
- Validation from **test data** (lab, ground and flight test) of **numerical and experimental predictions** of component, system and vehicle **performance**
- Validation of **predictive models** for environmental impact of production vehicle (**noise and emissions**)

NGCTR key technology drivers

- **Key objectives of NextGenCTR**:
  - CO_2 and Noise Footprint reduction
  - Reduced cost of ownership (operating & MRO)
  - High Efficiency, High Productivity
  - Fast Forward Speed

- **A set of key enabling technologies** have been identified for maturation and demonstration under CS2 program.

CS2 CPW04 – NGCTR Topic

Clean Sky 2

CS2 CPW04 – NGCTR Topics List

Identification Code	Title	WP	Indicative Start Date of activities	Indicative Duration (in months)	Indicative Value (funding in M€)	Type of Action
JTI-CS2-2016-CPW04-FRC-01-02	Design, manufacture and deliver a high performance, low cost, low weight wing for Next Generation Civil TiltRotor (NGCTR)	WP 1.4	Q4 2017	72	11	IA

Design, manufacture and deliver a high performance, low cost, low weight wing for Next Generation Civil TiltRotor (NGCTR)

CfP Header

2. Clean Sky 2 – Fast Rotorcraft IADP

I. Design, manufacture and deliver a high performance, low cost, low weight wing for CS2 Next Generation TiltRotor (NGCTR)

Type of action (RIA or IA)	IA		
Programme Area	FRC		
Joint Technical Programme (JTP V5) Ref.	WP 1.4 Advanced Fuselage and Tilting Wing		
Indicative Funding Topic Value (in k€)	11 000		
Topic Leader(s)	Leonardo Helicopters		
Duration of the action (in Months)	72	**Indicative Start Date**[4]	Q4 2017

Identification	**Title**
JTI-CS2-2016-CPW04-FRC-01-02	**Design, manufacture and deliver a high performance, low cost, low weight wing for CS2 Next Generation TiltRotor (NGCTR)**
Short description (3 lines)	
Working from a basic architectural definition; design, manufacture and test an innovative tiltrotor wing structure for experimental flight. Work will include supporting the wing integration into an innovative Tiltrotor Technology Demonstrator for the duration of the Clean Sky 2 programme and should include innovative, lightweight materials and industrialisation technologies along with provisions for TiltRotor air vehicle and avionics systems.	

Scope of work

Design, Develop & Manufacture, jointly with Leonardo Helicopters, a **Tiltrotor Wing** with the following functional requirements:

- **Interface with a main cabin section** (high wing configuration)
- Produce the required **lift** to allow the aircraft to achieve its defined flight envelope
- Have the **minimum** practical profile **drag**
- Withstanding leading edge **birdstrike**
- Withstand **ultimate loading** throughout the defined flight envelope
- Provide **sufficient life** to allow completion of the **TD flight test programme**
- **Prevent flutter** and other aeroelastic coupling effects between the wing and rotor system through all phases of flight, including abnormal attitudes
- Provide a mechanism to **reduce as much as practical the area of impingement between wing and rotor downwash** in hover and in transition to/from hover
- Provide the level of **HIRF protection** to meet required aircraft safety levels
- Provide a **wing tip interface with the nacelles** which house the engine, rotor system, tilting mechanism and associated gearboxes and ancillaries

Scope of work *(cont'd)*

Design, Develop & Manufacture, jointly with Leonardo Helicopters, a Tiltrotor Wing with the following functional requirements *(cont'd)*:

- Provide sufficient **access for systems maintenance**
- Provide space and attachment provisions for the following **systems**:
  - Fuel tanks and potential wet fuel cells in the wing and spar structure
  - Flap and aileron control surfaces
  - Fuel pumps, pipes and drains
  - Fuel dumping system
  - Actuators and control cables for control surfaces
  - AFCS and other avionics boxes
  - Provisions and separation for electrical looms
  - Protected space for interconnect drive shaft
  - Mid wing gearbox
  - Fire suppression systems

Considerations for post-Technology Demonstrator requirements:

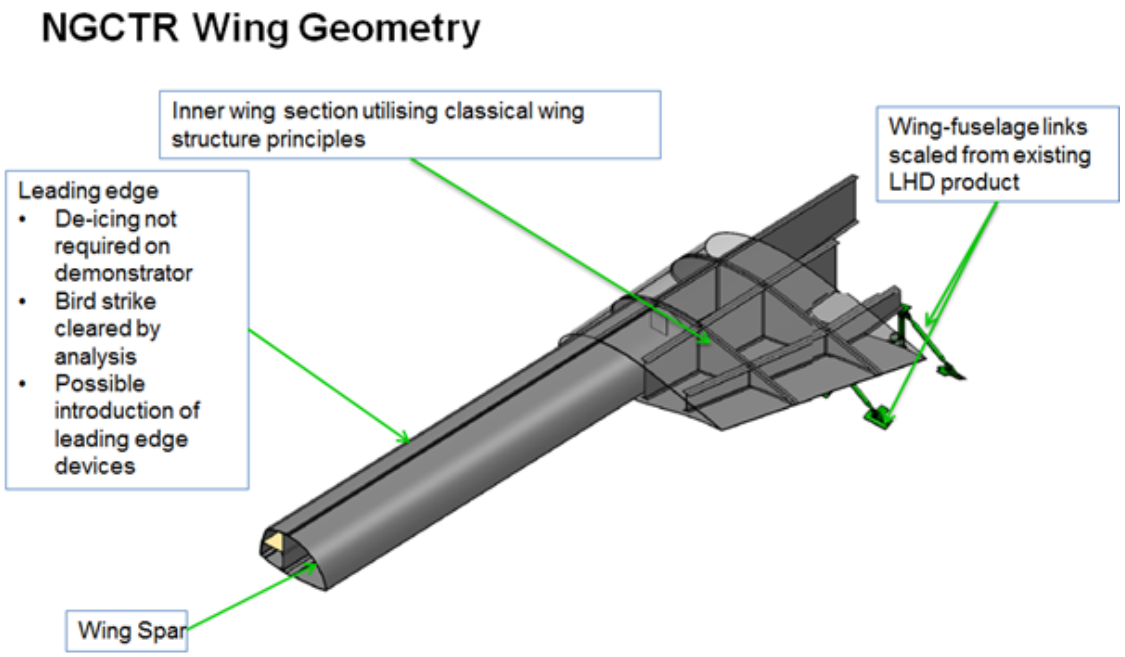
- Operation in known icing conditions
- To operate throughout the specified temperature ranges given in the BoC
- Embody direct/indirect lightning and full HIRF protection as necessary

NGCTR Wing concept

- It is required to mature this design to a level ready for manufacture and to then produce, test and deliver a wing for incorporation into the topic leader's flight test demonstrator

Approximate dimensions:
Span ≈ 12m
Chord ≈ 1.6m
Thickness/Chord ≈ 23%

The **wing spar is a single load path** whose failure would be catastrophic, making it a **critical part**.



- A further objective of the NGCTR programme is to exploit the technology and develop an aircraft that is scalable. The preliminary architectural layout is to be analysed and a final concept chosen based on the potential for scalability.

Core Partner Responsibilities

- **Developing** along with the Topic Leader **a suitable low weight wing** with stiffness tailoring provide acceptable aeroelastic characteristics
- **Preliminary and Detailed design** of the NGCTR TD Wing
- Create, support and maintain a **digital mock-up** of the structure using CATIA V5.
- Production of a **compliance plan to the agreed BoC** for the relevant configuration in support of the achievement of the complete aircraft for “Permit to Fly”
- **Assisting the TL with the BoC** in areas pertinent to the wing
- Performing the **detailed stress analysis** of the wing
- Achieving the agreed **weight targe**ts
- Selection of **materials and manufacturing processes** in association with the TL
- Production of any **test plan and analysis** of test results necessary **to achieve PtF**
- **Definition of any inspections required**
- Provide a study about **structural implications of scaling the TD wing solution**
- Production of **flight test instrumentation** requirements and telemetry monitor limits
- Provide **airworthiness evidence** to allow the achievement of PtF fly for NGCTR TD
- **Support to flight test programme**

Testing

- The Core Partner shall **design and build all test specimens** (including instrumentation), **test rigs and perform all the testing** of the wing which is necessary to obtain a Permit to Fly for the NGCTR TD.
- The following **tests and test articles** are envisioned:
  - **Full scale fatigue test** to achieve sufficient hours for the flight demo program
  - **Residual static strength** testing up to ultimate load values post fatigue testing using the fatigue test specimen
  - **Coupon testing** to develop any **material properties** necessary for the inclusion of new or novel construction materials
  - **Component sub assembly tests** to develop and prove any **novel construction or manufacturing processes**
  - **Experimental Bird Strike clearance** shall consider development of innovative advanced simulation and high accuracy models to mitigate the need for physical testing.
- The instrumentation requirements shall be jointly agreed to ensure the compatibility with the data acquisition systems (Ground and Flight).

Manufacture

- Focus on **light weight low cost, rapid manufacturing** techniques.
- The Core Partner shall be responsible for:
  - Manufacture a conforming instrumented test specimen
  - Manufacture and deliver to the Topic Leader an experimental flight worthy wing instrumented with the requisite sensors to verify Core Partner design requirements
  - Design and procure all the required manufacturing tooling
  - Sourcing of all raw materials and all bought out components (if any)
  - Provide all quality documentation for structural elements, quality methods substantiation documentation and a quality plan
  - Provide a description of applied manufacturing processes and quality documentation
- Development and maturation of new techniques and processes embodying a virtual factory concept aimed at improving cost, process and quality control, such as:
  - Composite curing and assembly process simulation
  - Use of low cost / low batch tooling
  - Out-of-autoclave techniques
  - Automation for manufacturing and inspection and Robust quality control

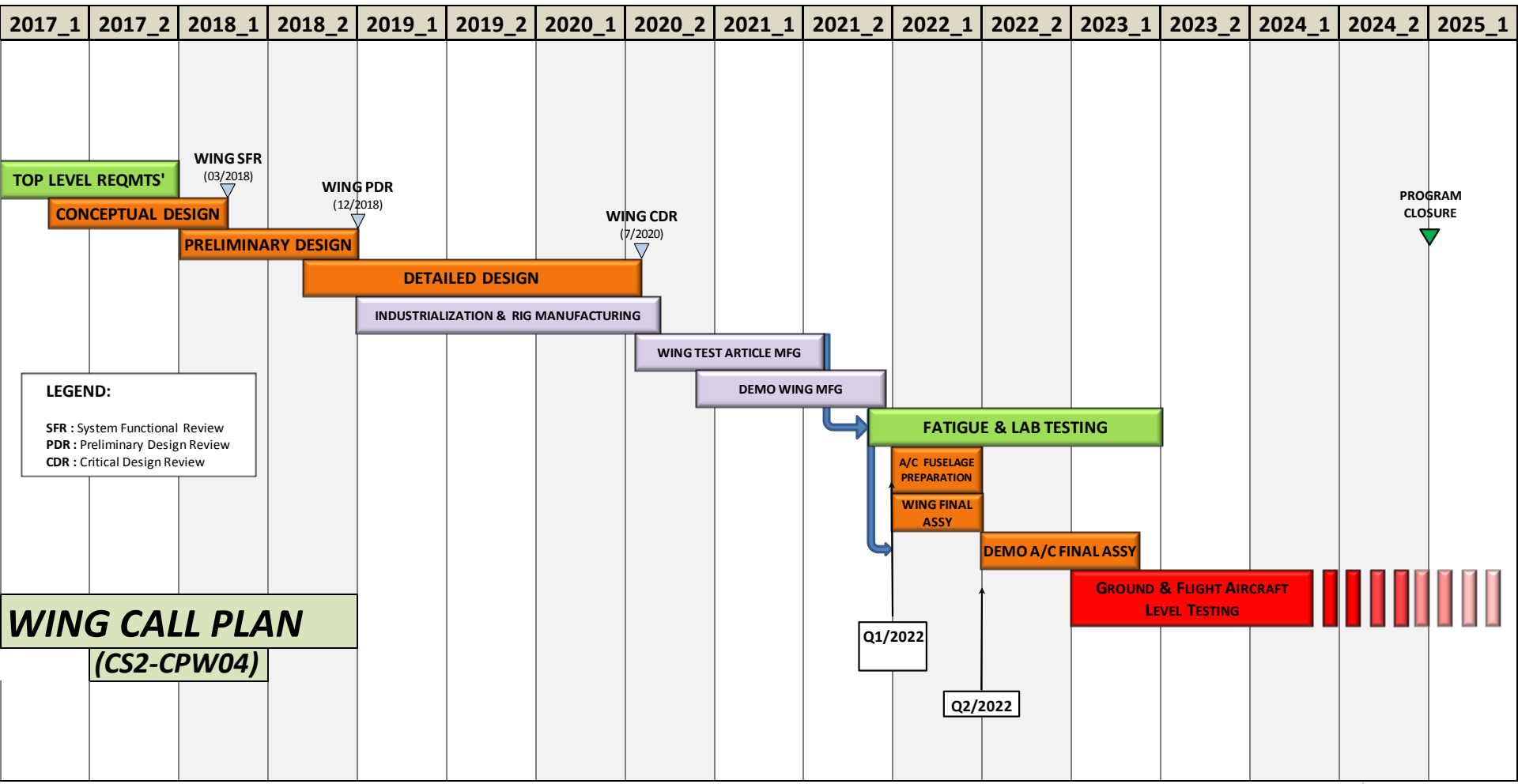
Project Implementation

Deliverables			
Ref. No.	Title – Description	Type	Due Date
1	Minutes of NGCTR TD Wing System Requirement Review (SRR)	R	Q2 2018
2	Minutes of NGCTR TD Wing Preliminary Design Review (PDR)	R	Q3 2018
3	Minutes of NGCTR Wing TD Critical Design Review (CDR)	R	Q2 2019
4	NGCTR TD Wing Design Data Set and Interface Definition Documents	R	Q3 2019
5	Minutes of NGCTR TD Test Readiness Review (TRR)	R	Q3 2019
6	First Article Inspection Report	R	Q1 2020
7	NGCTR TD Wing Qualification Reports	R	Q4 2020
8	Wing Static and Fatigue Test Report	R	Q2 2021
9	Wing Stress Report	R	Q2 2021

As a **risk mitigation measure**, **conventional manufacturing processes and materials** may be considered where it can be demonstrated that there is a **time or cost benefit without any adverse effect** on the scope and validity of the flight test programme.

Milestones (when appropriate)			
Ref. No.	Title – Description	Type	Due Date
1	System Requirements Review	RM	Q2 2018
2	Preliminary Design Review	RM	Q3 2018
3	Critical Design Review	RM	Q2 2019
4	First Article Inspection	RM	Q1 2020
5	Test Readiness Review	RM	Q3 2019
6	Delivery of NGCTR TD Wing	D	Q4 2020

Master Plan



Applicant requirements

Suitable Core Partner(s) across the proposed team shall:

- Have a proven track record of the construction of aircraft structures
- Be experienced in the design and manufacturing of structures in non-conventional and conventional composite and metallic materials
- Have capability to manufacture and assemble composite and metallic parts
- Use design, analysis and configuration management tools of the aeronautical industry
- Have the capacity to support the achievement of “Permit to Fly”
- Be capable of specifying and conducting material and structural tests incl. full scale
- Have qualification competences: design organization approval (DOA) is desirable but not mandatory
- Be capable to manufacture, test, checks aerostructure components to assure the required production quality
- Have access to the qualification process to obtain the “Permit to Fly” of the NGCTR
- Be capable of designing and manufacturing/procuring applicable tooling and assembly jigs

Applicant requirements

Suitable Core Partner(s) should:

- Have experience of collaborating with industrial partners, institutions, technology centres, universities and OEMs (Original Equipment Manufacturers) within international R&T projects
- Have a Quality System approved to international standards (i.e. EN 9100:2009/ ISO 9001:2008/ ISO 14001:2004)
- Be capable of supporting the overall aircraft configuration management
- Be capable of performing Life Cycle Analysis (LCA) and Life Cycle Cost Analysis (LCCA) of materials and structures

Disclaimer: Fast Rotorcraft IADP