Clean Sky 2
Information Day dedicated to the 10th Call for Proposal (CfP10)

FAST ROTORCRAFT IADP

Topics related to FRC WP1 – Next Generation Civil TiltRotor Project

Leonardo Helicopters

Innovation Takes Off

www.cleansky.eu

Clean Sky 2

FRC Overview
Filling the Mobility Gap

MISSIONS

EMS, SAR,
Coast guard
Disaster relief
Oil & Gas offshore

Corporate Transport
Air Taxi

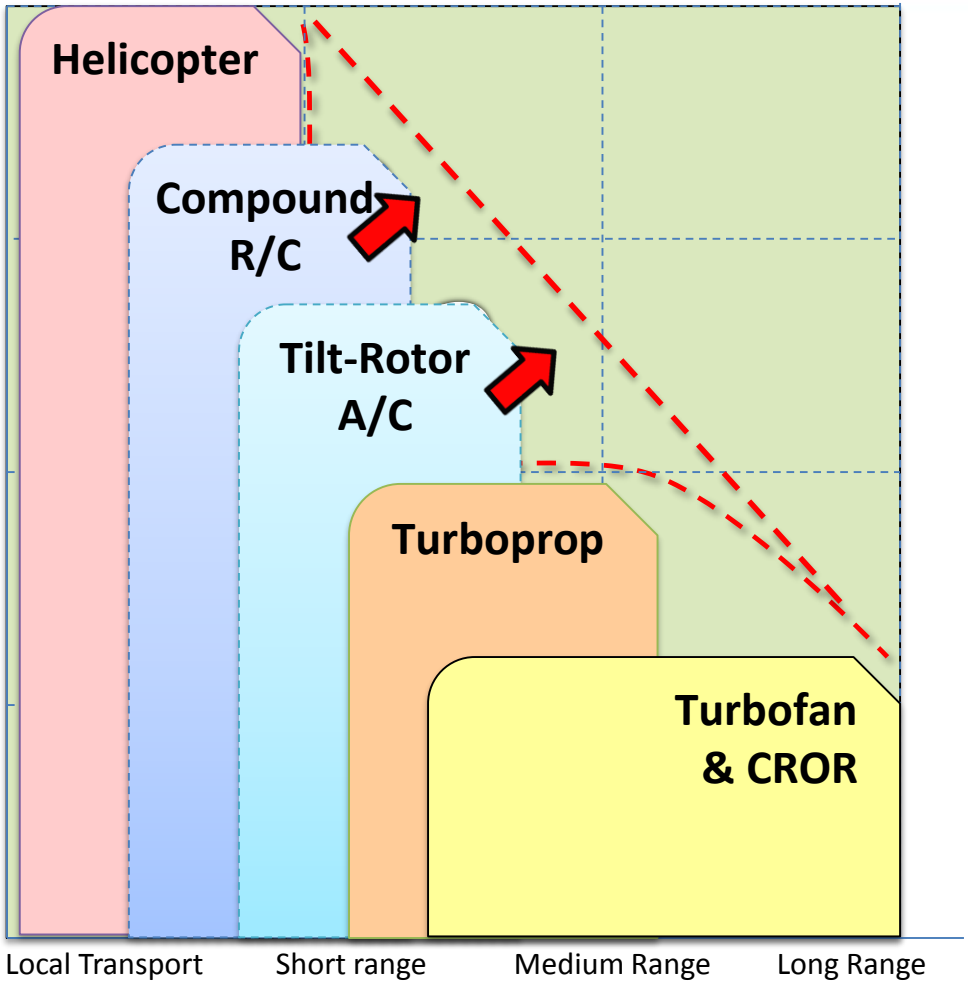
AIRFIELD

Unprepared Area
Helideck
Door-to-Door

Heliport
Local airfield

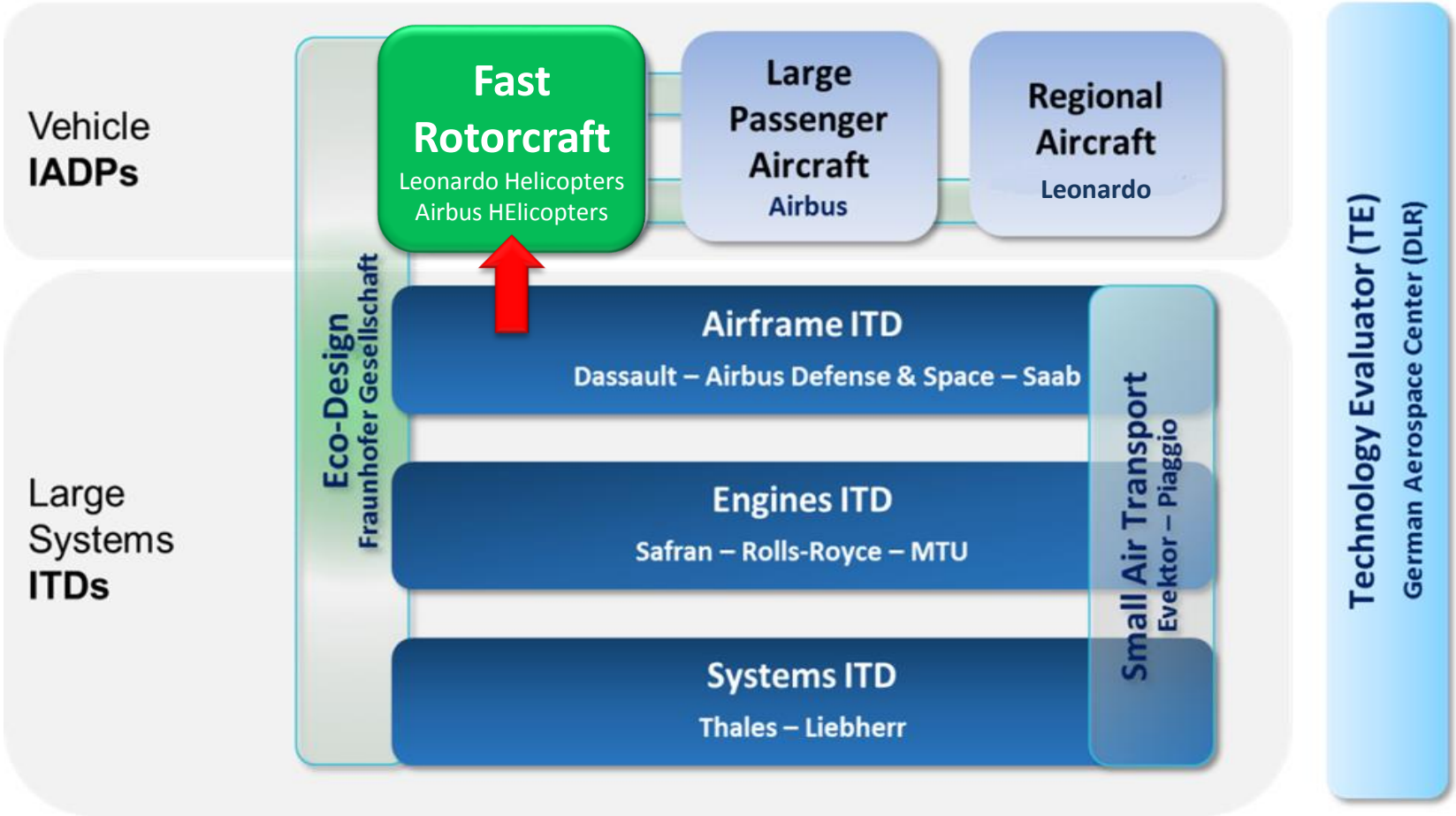
Regional
Airport

Large Airport

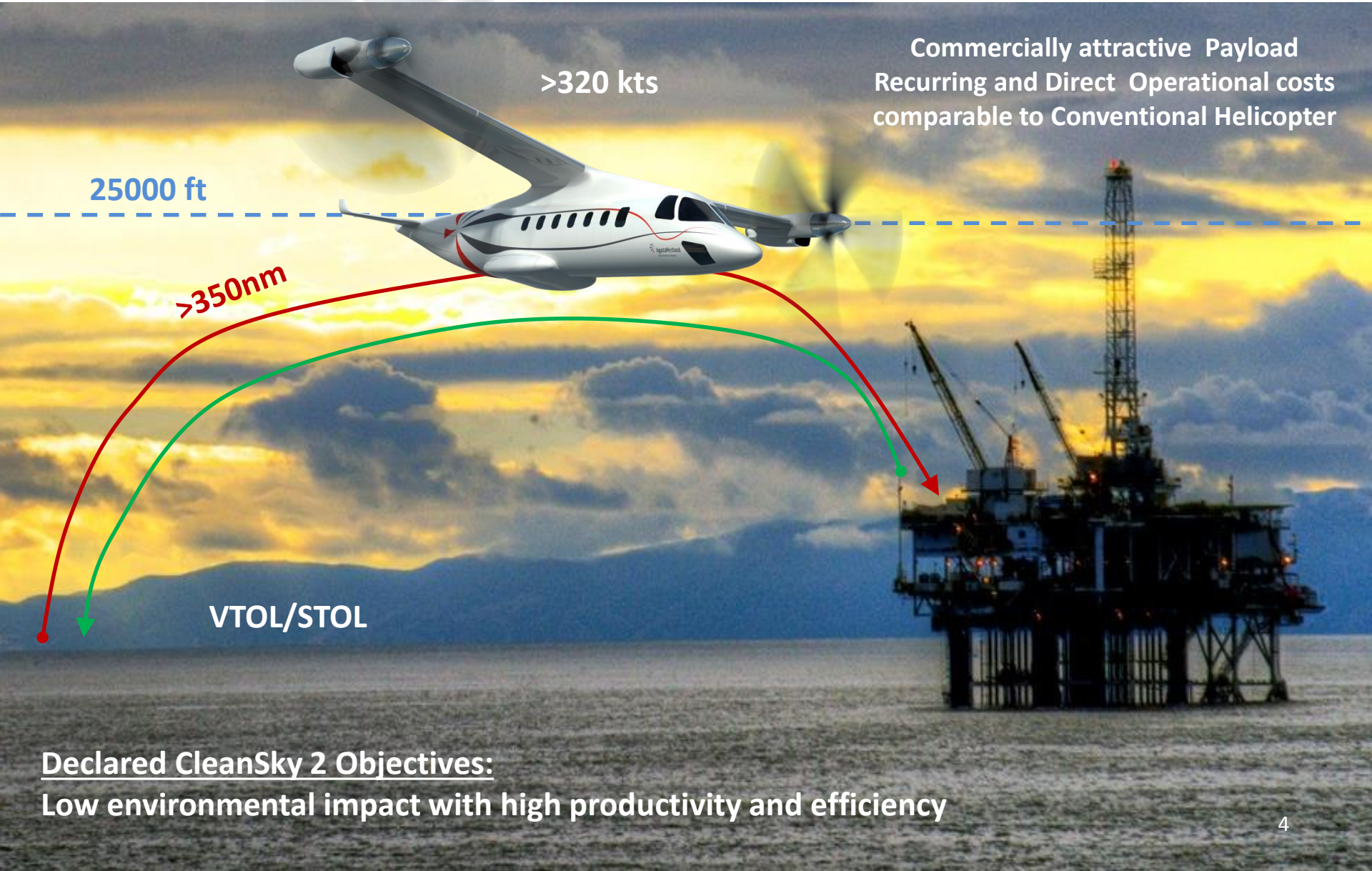


TRANSPORT RANGE & PRODUCTIVITY

FRC Overview
Clean Sky 2 Context



FRC Overview
NextGenCTR Objectives and Challenges



Declared CleanSky 2 Objectives:

Low environmental impact with high productivity and efficiency

Approach for NextGenCTR Program: 2 Phases

NextGenCTR

A 2-Phase Program

Phase 1

Design, Build, Fly a

Technology Demonstrator under CS2

NextGenCTR TD

- **De-risk program, expand current TR capability**
- Prove Architecture, Technologies, Operations
- Supported by external funding
- Develop collaborations and partnerships
- Sow the seeds for future technologies & products
- Technology exploitation and dissemination

if the market is ripe
on-going business case development

Phase 2

Develop & Certify a Product

NextGenCTR

- Tailored for diverse missions
- State-of-the-art Technologies embedded
- Competitive RC & DOCs vs. Helicopters
- No Legacy with AW609 technologies

Clean Sky
JOINT UNDERTAKING

FRC IADP
NGCTR-TD Objectives

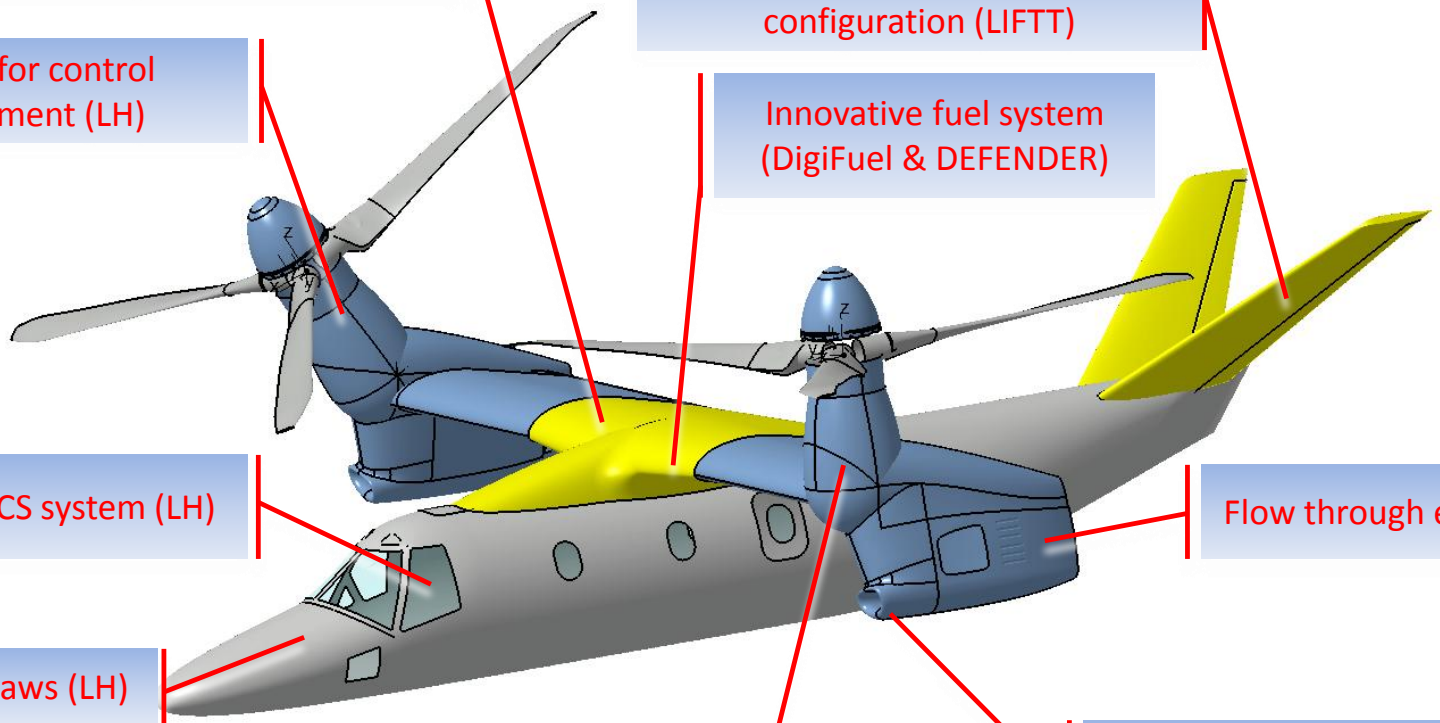
Key objectives will be pursued within CS2 by a Technology Demonstrator focusing on the Design & Development effort of **Key Enabling Technologies**:

1. Fixed-engine, Split Gearbox Drivetrain concept
2. Efficient Nacelle architecture
3. Advanced Wing architecture
4. Optimized Tail configuration
5. Advanced Modular, Distributed & Scalable Flight Control System

Throughout this effort the development and validation of predictive models and tools for air vehicle performance (including environmental), efficiency and productivity

FRC IADP
NGCTR-TD Objectives

New Technologies to be tested within CS2 for First Flight (TRL =6)



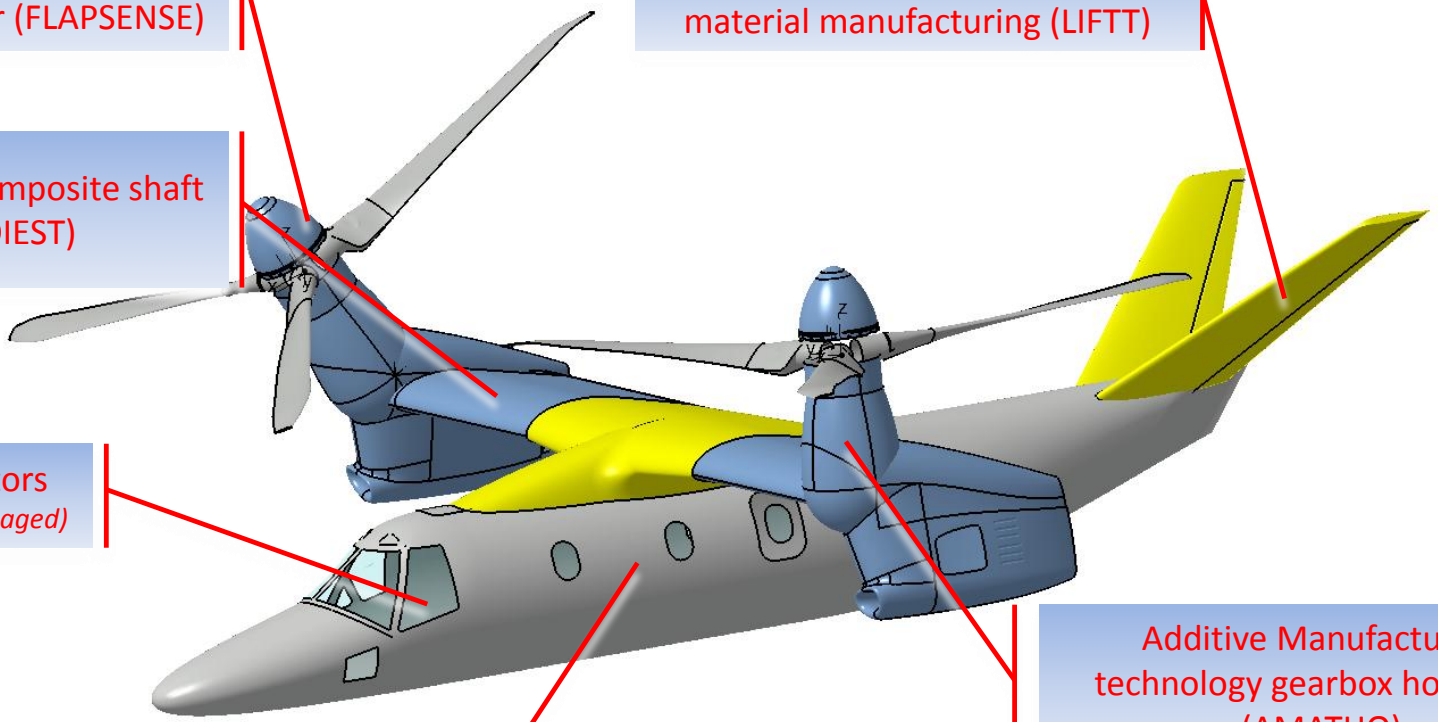
FRC IADP
NGCTR-TD Objectives

New Technologies to be tested within CS2 after First Flight (TRL =<6)

Wireless Slipring (CONSTANCE) & Innovative Flapping Sensor (FLAPSENSE)

New tailcone & empennage material manufacturing (LIFTT)

Supercritical composite shaft (STEADIEST)

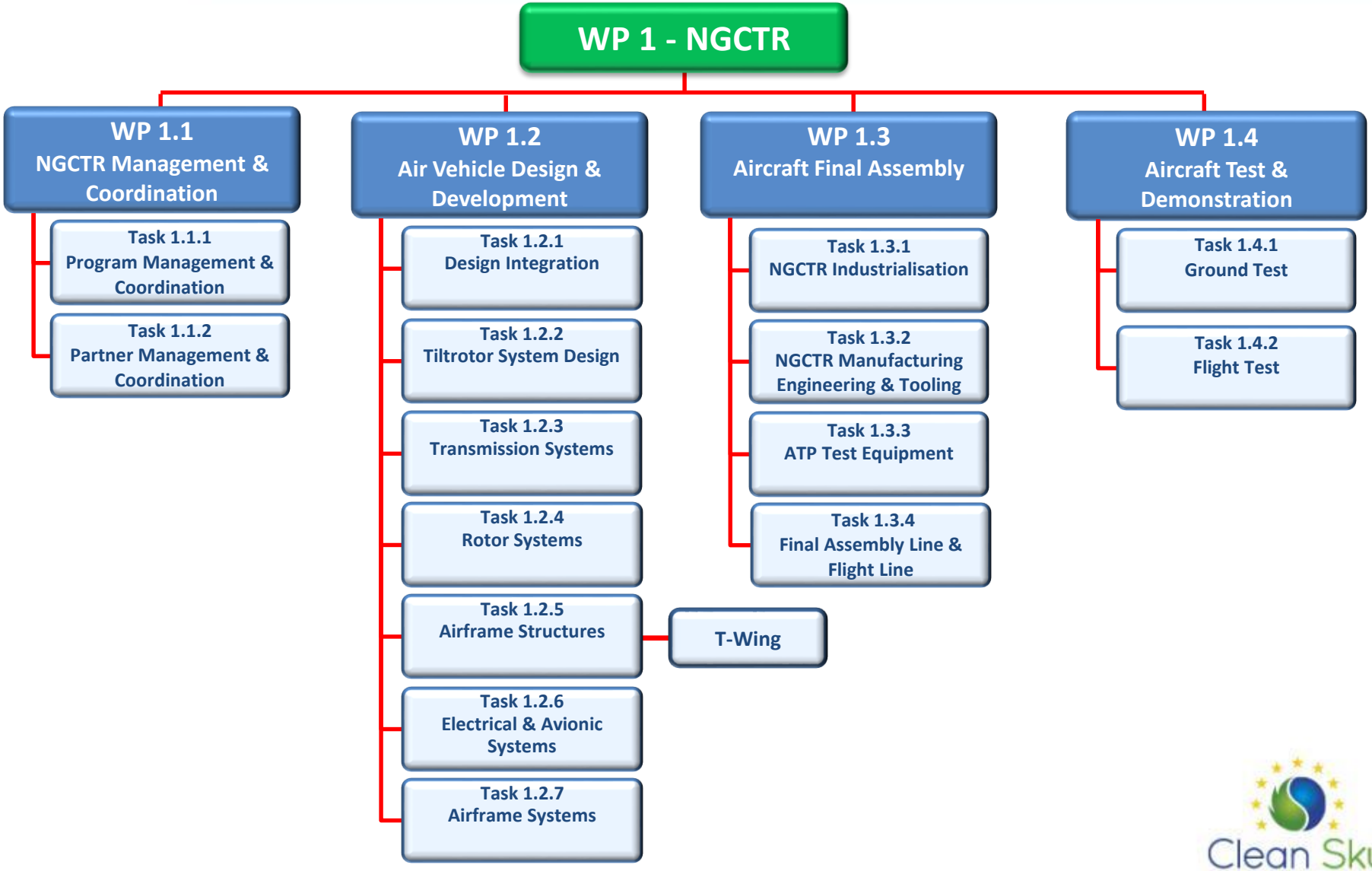


Active inceptors
(Partner to be engaged)

Additive Manufacturing technology gearbox housing – (AMATHO)

General System new applications (i.e. Electrical low pressure compressor, ...) (ELECTRA)

FRC IADP
NGCTR-TD Work Package Structure



NGCTR WBS - Clean Sky 2 Demonstrators Definition & Plan

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

D10 4. Optimized Tail configuration

D6 2. Efficient nacelle architecture D7

D5 3. Advanced Wing architecture

D4 1 .Fixed-engine, Split gearbox drivetrain concept

D9

D8 5. Advanced Modular, Distributed & Scalable FCS

D1 Wind Tunnel Model

D2 TDH – Tie Down Tilt Rotor

D3 Flying Demo

D4 Drive system and components

D5 Wing Assembly

D6 Engine-nacelle integration

D7 Fuel system components

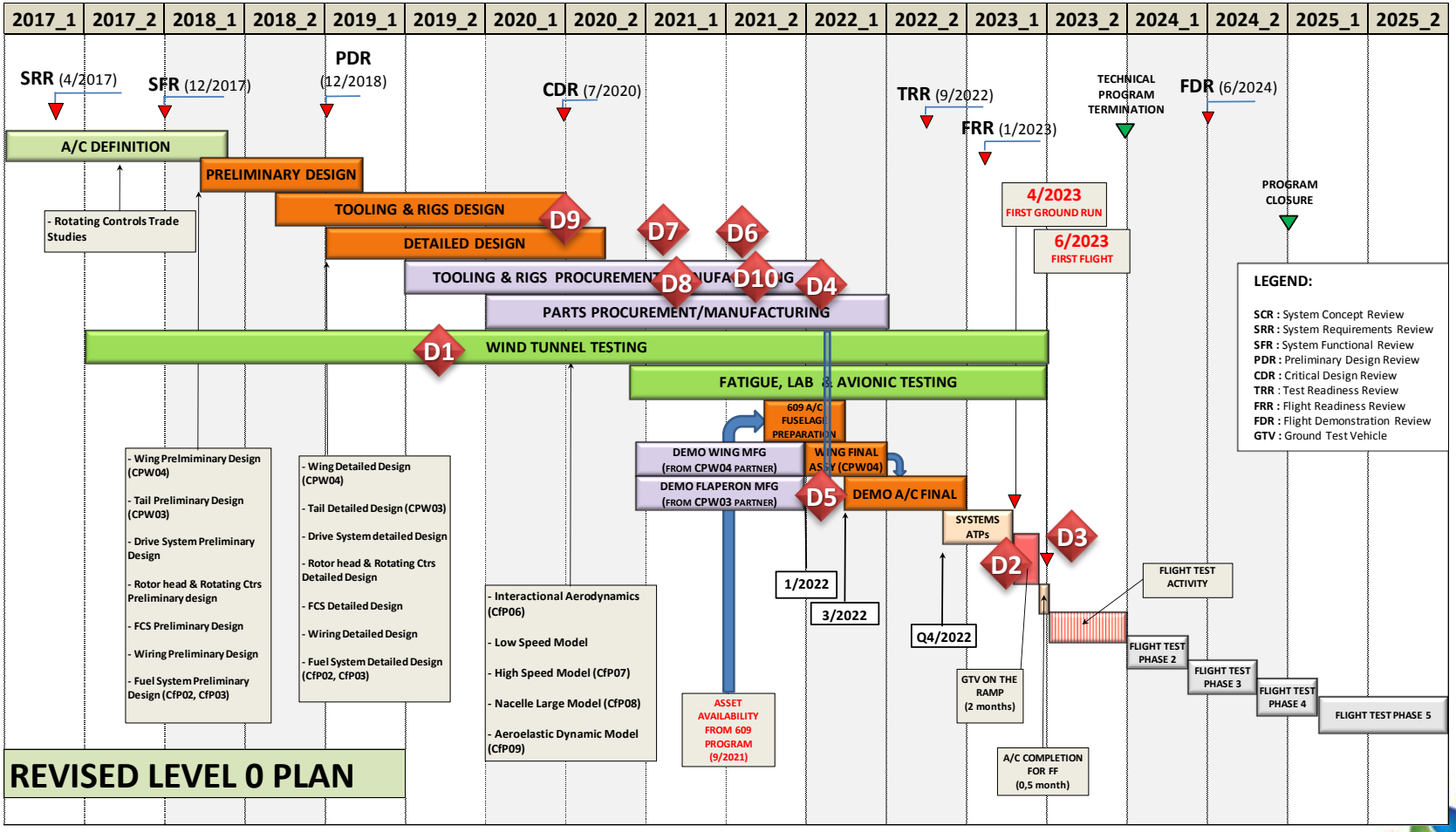
D8 Flight control and Actuation systems and components (SaIL)

D9 Digital Mock-Up (DMU)

D10 Airframe Structural Components

NGCTR WBS - Clean Sky 2 Demonstrators Definition & Plan

Master Level "0" Plan Status:



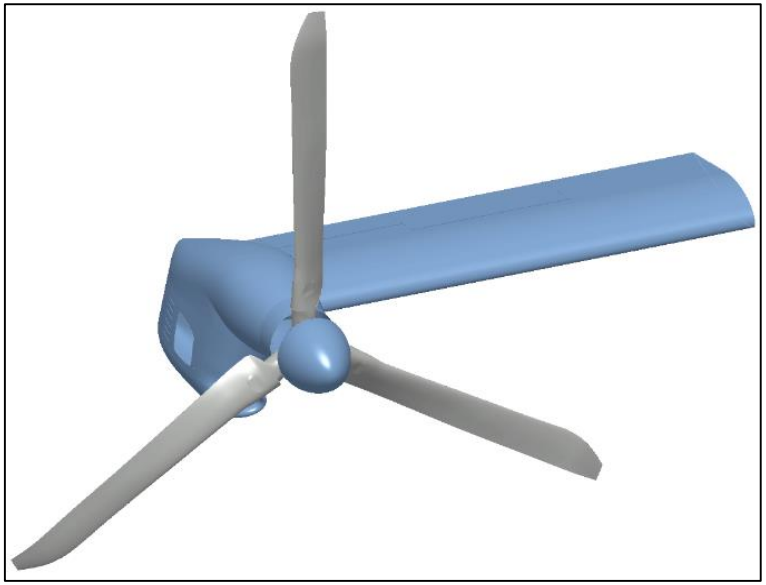
10th Call for Proposal (CfP10) – Fast RotorCraft IADP

- **FRC-01-28:** Innovative kinematic analysis to incorporate multiple functions within a movable surface
- **FRC-01-29:** Smart Active Inceptors System development for Tilt Rotor application
- **FRC-01-30:** Multipurpose bench for Tilt Rotor equipment functional test

Fast RotorCraft IADP
10th Call for Proposal
Info-Day

FRC-01-28: Innovative kinematic analysis to incorporate multiple functions within a movable surface

FRC-01-28: Innovative kinematic analysis to incorporate multiple functions within a movable surface



- Topic Manager: **Leonardo Helicopters**
- Collab.= Implementation Agreement
- Indicative Funding Value: **500 K€**
- Duration: **24 Months**
- Type of Action: **RIA**
- Overview:
  For the Next Generation Civil Tilt Rotor configuration a wing movable surface able to be used for multiple functions (download alleviation, flap, aileron) shall be investigated.
- Objective:
  To investigate innovative concepts for such movable surfaces addressing potential actuators families and installation schemes to incorporate those functions.

FRC-01-28: Innovative kinematic analysis to incorporate multiple functions within a movable surface

Workpackages (cont'd)

WP1: Capture of the relevant subsystem requirements to be satisfied

- The Applicant shall capture the requirements that the movable subsystem has to guarantee, in agreement with the general aircraft behaviour and control, in a fully integrated manner with the other relevant wing components
  - **Dowload alleviation**
  - **Roll axis controllability**

WP2: Preliminary study of 3 different proposed concepts

- The Applicant shall investigate and propose three different concepts able to fit WP1. Each of these three concepts shall allocate specific functions in order to match the needs. The studies will including the aerodynamic loads during the surfaces deployment

FRC-01-28: Innovative kinematic analysis to incorporate multiple functions within a movable surface

Workpackages

WP3: Feasibility study of the selected concept

- The Applicant shall develop in detail the concept chosen in WP2. This Workpackage will be supported by a most accurate aerodynamics analysis (CFD) in order to identify the necessary set of loads acting on the movable surfaces during the deployment phase and at the fixed position.

WP4: Mock-up of the selected concept

- The Mock-up, fully representative of the selected concept, shall include all its relevant items, as embedded into the associated specimen of the fixed part of the wing. The mock-up is not a flyable item. Availability of the Mock-up is part of the exit criteria of the PDR.

FRC-01-28: Innovative kinematic analysis to incorporate multiple functions within a movable surface

Expected capabilities from the Applicant

- Computational resources (hardware and software) suitable for the scopes of the activities in the specified timescale
- Knowledge in actuator kinematics
- Capability to evaluate aerodynamics loads
- Capability in engineering integration of devices and subsystems
- Proven capability to manage projects by gathering several and different specialistic skills (numerics, flow field analysis, optimization) and demostrated capability to guarantee the project scheduling and milestones.

Fast RotorCraft IADP
10th Call for Proposal
Info-Day

FRC-01-29: Smart Active Inceptors System development for Tilt Rotor application

FRC-01-29: Smart Active Inceptors System development for Tilt Rotor application

- Topic Leader: **Leonardo Helicopters**
- Type of Agreement: Implementation Agreement
- Indicative Funding Value: **3.500 M€**
- Duration: **39 months**
- Type of Action: **IA**
- Overview:
  Starting from ergonomic and functional requirements, it will be required to optimise design in order to define the best configuration, considering weight, volumes, power consumption, complexity, integration, availability, reliability.
- Objective:
  - ❑ To manufacture and qualify an optimised active inceptors system for Tilt Rotor application.

FRC-01-29 Smart Active Inceptors System development for Tilt Rotor application

Background

The Call requires Applicant/s to provide innovative engineering solutions for the NGCTR Technology Demonstrator cockpit inceptors.

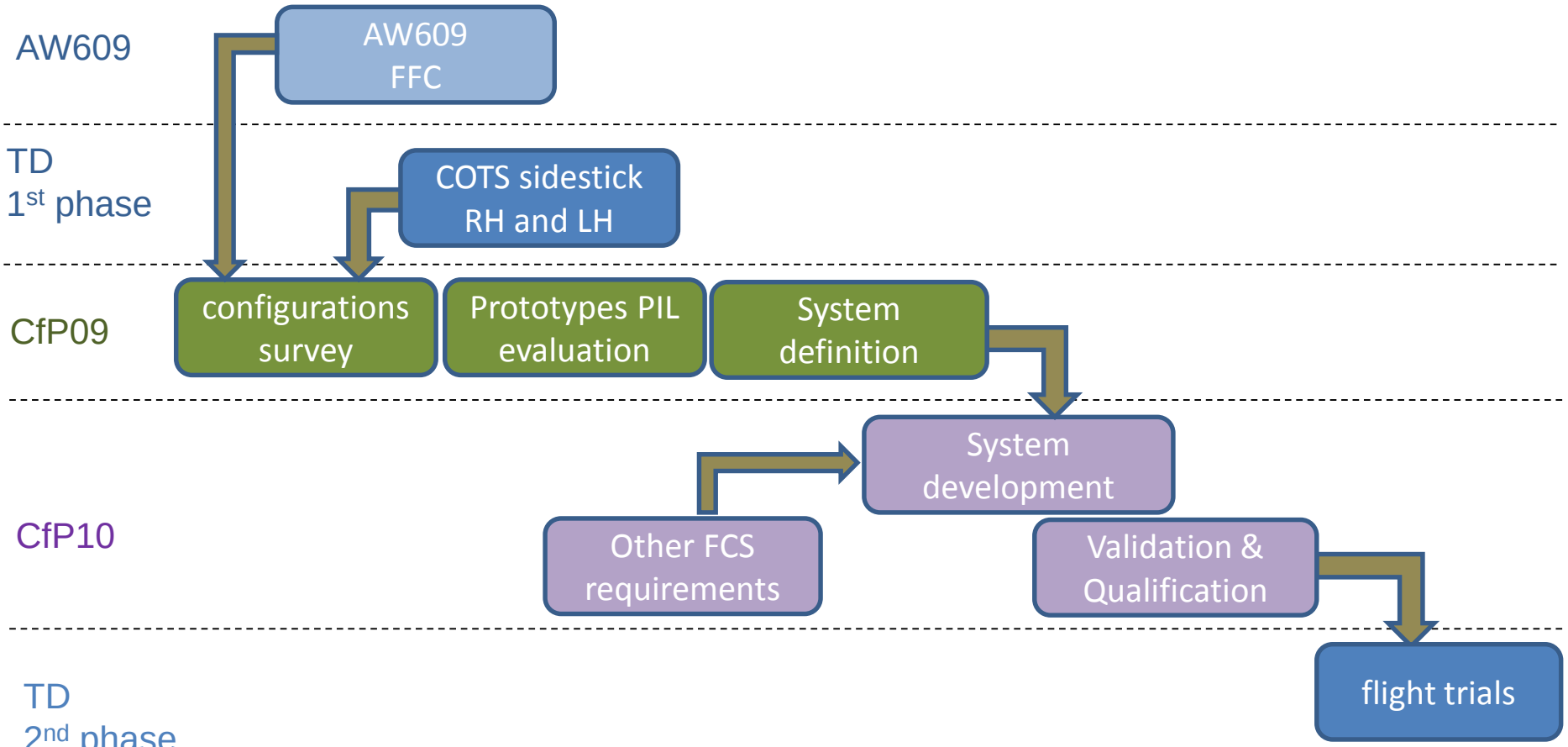
The Inceptors System shall allow aircraft control by translating the pilots' inputs into digital commands to the FCS, by means of pilot's and co-pilot's **right-** and **left-hand active inceptors**, and of pilot's and co-pilot's **pedals**.

Ergonomic requirements, including the type of controls (e.g. sidestick or throttle or a new kind of configuration) and haptic functionalities, will be given during **early phase** of the activities.

It is therefore important that Applicant/s are **flexible** and ready to **deviate** from their baseline implementation, if any, to comply to new requirements, when they will be available (rouglhy, 6 months after start of call activities).

FRC-01-29 Smart Active Inceptors System development for Tilt Rotor application

Leonardo Helicopters Active Inceptors System Development Strategy



FRC-01-29 Smart Active Inceptors System development for Tilt Rotor application

Scope of work (1/3)

- Each inceptor is capable to provide feedbacks to the pilot by means of real-time **force** and/or **haptic feedbacks** (see **SAE ARP 5764**).
- Each pair of equivalent inceptors (i.e., pilots' and co-pilot's right-hand inceptors, pilots' and co-pilot's left-hand inceptors, pilots' and co-pilot's pedals), are controlled to **simulate** a **mechanical linkage** between the two grips and to ensure that pilots' inputs are coordinated and consistent.

Scope of work (2/3)

- The system is a **flight critical** components of the FCS: its design shall guarantee adequate **integrity** to make sure that single or combined failures (within processing, electrical or mechanical domain) causing the pilots' command to get stuck, lost or corrupted are probabilistically irrelevant.
- The system shall be suitable for dual-pilots operation. As basis of certification, **single-pilot IFR** operation has to be considered (to be confirmed prior of PDR).
- The **integration** of the system within FCS by only means of digital communication has to be reliably implemented.

FRC-01-29 Smart Active Inceptors System development for Tilt Rotor application

Scope of work (3/3)

- Starting from ergonomic and functional requirements, it will be required to **optimise** the design in order to define the best configuration, considering **weight**, **volumes**, **power consumption**, **complexity**, **integration, installation**, **availability**, **reliability**.
- The activity of the call culminates with the delivery of a **Smart Active Inceptors System qualified** for experimental flight trials on NGCTR tiltrotor application.

FRC-01-29: Smart Active Inceptors System development for Tilt Rotor application

Expected capabilities from the Applicant (1/2)

- ❑ Experience in aeronautic rules, certification processes and quality requirements.
- ❑ Experience in design, validation, manufacturing and environmental/functional qualification of airborne equipment, either cockpit flight control systems, avionic systems (embedding complex HW and DAL-A SW) or both, according to RTCA-DO-160, RTCA-DO-178 and RTCA-DO-254 (or other civil or military equivalent standards) for safety critical equipment.
- ❑ Capacity to design complex electronic HW in compliance with EMC guidelines, and experience in performing EMC justification analyses and experimental assessments according to RTCA-D0-160, EUROCAE ED-107/ARP-5583, ED-81/ARP-5413 and ED-84/ARP-5412 or equivalent civil or military standards
- ❑ Experience in research, development and manufacturing (or integration) in one or more of the following technology fields:
  - Cockpit flight controls, with particular emphasis on active stick design as per SAE-ARP-5764 guidelines.
  - High performance DC brushless servomotors and drive systems,
  - Compact and reliable sensors and switches.
  - High integrity control electronics.
  - Grip ergonomic design and optimisation.

FRC-01-29: Smart Active Inceptors System development for Tilt Rotor application

Expected capabilities from the Applicant (2/2)

- Well proven engineering and quality procedures capable to produce the necessary documentation and means of compliance to achieve the “Safety of Flight” with the applicable Airworthiness Authorities (FAA, EASA, etc.).
- Experience in application of System Engineering processes as per SAE-ARP-4754A and safety analysis processes as per SAE-ARP-4761.
- Capability to develop, manufacture, and qualify Mechatronic devices.
- Capability to carry out component design and structural analysis (e.g. using CATIA v5, NASTRAN or similar tools)
- Capacity to optimize the HW and SW design, to model complex mechatronic systems with suitable simulation tools and to analyze both simulation and experimental results to ensure required performance goals are met.

Fast RotorCraft IADP
10th Call for Proposal
Open Day

FRC-01-30: Multipurpose bench for Tilt Rotor equipment functional test

FRC-01-30: Multipurpose bench for Tilt Rotor equipment functional test

- Topic Manager: **Leonardo Helicopters** ;
- Collab.= Implementation Agreement
- Indicative Funding Value: **800 k€ ;**
- Duration: **36 Months**
- Type of Action: **IA**
- Overview:

  Functional Test activities are required during the Final Assembly of an Aircraft in order to verify if, after the equipments installation, the functional requirements are in conformity with the design data set.
- Objectives:

  The Main Content of this Topic is to design, manufacture and test an innovative equipment to perform functional testing at aircraft level through execution of simultaneous and integrated electro-avionics checks on aircraft equipment in order to reduce final assembly time.

FRC-01-30: Multipurpose bench for Tilt Rotor equipment functional test

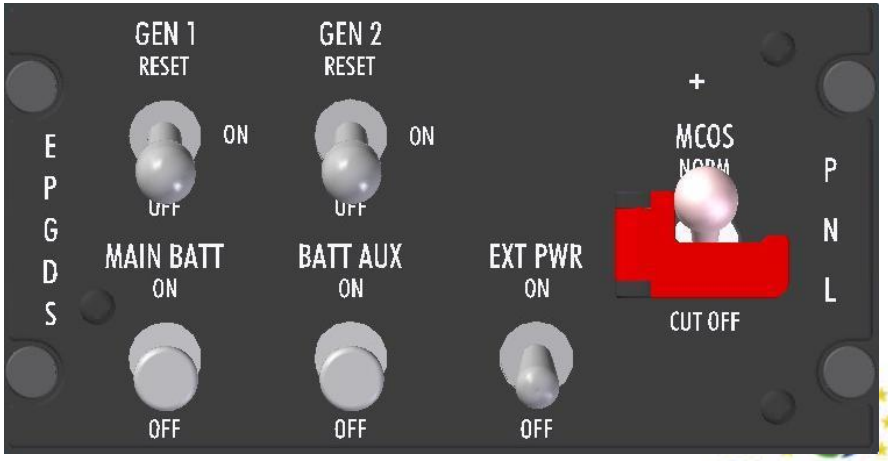
EGPDS

- The Electrical Power Generation and Distribution System (EPGDS) generate and distribute electrical power to the rotorcraft electrical power utilization equipment via the secondary distribution panels

- The EPGDS provides DC sources of generated power to the aircraft. Associated equipment provides for energy conversion, energy storage, control protection, monitoring and indication to the flight crew and distribution to required electrical loads.

- Manual selection of power sources is possible from control panels in the cockpit. System failure indications are made available to the cockpit crew on the Cockpit Display System

The EPGDS Control Panel is installed in the interseat console.
The Control Panel is installed in the interseat console

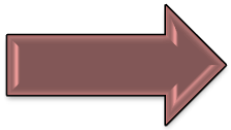


FRC-01-30: Multipurpose bench for Tilt Rotor equipment functional test

AUTOMATED TEST BENCH PURPOSE

AS IS

- ❑ Manual Test Set up
- ❑ Manual Test Execution
- ❑ Paper Report + scan
- ❑ Golden Item Usage WCC
- ❑ Engineering Support for Fault



TO BE

- ❑ Automatic Test Set up
- ❑ Automatic Test Execution
- ❑ Digital Report
- ❑ Smart Assistant Fault
- ❑ Emulators, No Golden item

ACTUAL PROCESS FACTORS TO BE IMPROVED:

- Repetition of Standard activities→ **AUTOMATION** operator during functional test spend different hour to connect/disconnect cables, generating time consuming that in several industrial application are superseed by automation.

- Error Detection → **DATA BASE-SMART ASSISTANT**: During functional test activity, if the operator detects anomalies, he has to stop the test and troubleshoot the problem, or, in worst case, escalate to manufacturing Engineering and Engineering Department to solve the issue.

- Emulators → **GOLDEN ITEM AVAILABILITY** : Possibility to Use Emulators (PDU's, Control Panel, Circuit Breaker Panel) in case real equipment is not available, in order to reduce production Lead Time

FRC-01-30: Multipurpose bench for Tilt Rotor equipment functional test

AUTOMATED TEST BENCH PURPOSE

TWO-PHASES PROJECT

Phase 1: For the NGCTR TD first flight phase (across 2023) the main activity will be oriented to generate an equipment able to manage with an automated process the testing required for, as a minimum, the Electrical Power Generation System, keeping avionic FTPs' as an option.

Phase 2: (Parallel/subsequent TD flight testing phases): During this phase a Development activity will be conducted to analyze and simulate the multi-integrated FTPs, including Avionic requirements, with reference of TD configuration and further analysis for larger Tiltrotor.