Clean Sky Joint Undertaking
Call SP1-JTI-CS-2010-03

European Commission
Research Directorates

Call for Proposals:

CLEAN SKY
RESEARCH and TECHNOLOGY DEVELOPMENT PROJECTS
(CS-RTD Projects):

Call Text

Call Identifier
SP1-JTI-CS-2010-03

Index

Document track changes

Page/topic	*Original*	*Correction or modification*

Introduction

Via the Calls for Proposal, Clean Sky aims to incorporate Partners to address very specific tasks which fit into the overall technical Work Programme and time schedule.

Due to the nature of these tasks, the Call is not set up using a set of themes, but it is conceived as a collection of very detailed Topics. The Call text therefore consists of a set of topic fiches, attached here.

Each Topic fiche addresses the following points:

- Topic manager (not to be published)
- Indicative start and Indicative End Dates of the activity
- Description of the task
- Indicative length of the proposal (where applicable)
- Specific skills required from the applicant
- Major deliverables and schedule
- Maximum Topic Budget value
- Remarks (where applicable)

The maximum allowed Topic budget relates to the total scope of work. A Maximum funding is also indicated.

Depending on the nature of the participant, the funding will be between 50% and 75% of the Topic maximum budget indicated. It has to be noted that the Topic budget excludes VAT, as this is not eligible within the frame of Clean Sky.

Eligibility criteria

All applicants are requested to verify their actual status of "**affiliate**" with respect to the members of the relevant ITD for whose topic(s) they wish to submit a proposal.
Applicants who are affiliated to any leader or associate of an ITD will be declared not eligible for the topics of that ITD.
Refer to art.12 of the Statute (*Council Regulation (EC) No 71/2007 of 20 December 2007 setting up the Clean Sky Joint Undertaking*) and to page 8 of the Guidelines.

The Topics proposed by the ITDs are listed in the next table.

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-ECO	**Clean Sky - EcoDesign**	**4**	**740.000**	**555.000**
JTI-CS-ECO-01	*Area-01 - EDA (Eco-Design for Airframe)*		**740.000**	
JTI-CS-2010-3-ECO-01-004	Development and implementation of Magnesium sheets in A/C		70.000	
JTI-CS-2010-3-ECO-01-005	Integration development of a wireless strain monitoring system with a simulation tool		250.000	
JTI-CS-2010-3-ECO-01-006	Enhanced local heating device capable of high and homogeneous temperature for the repair of large composite damages		220.000	
JTI-CS-2010-3-ECO-01-007	Accelerated fatigue testing methodology for fiber reinforced laminates for aircraft structures		200.000	
JTI-CS-ECO-02	*Area-02 - EDS (Eco-Design for Systems)*			
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	**4**	**840.000**	**630.000**
JTI-CS-GRA-01	*Area-01 - Low weight configurations*		**0**	
JTI-CS-GRA-02	*Area-02 - Low noise configurations*		**510.000**	
JTI-CS-2010-3-GRA-02-010	Advanced concepts for trailing edge morphing wings: design and manufacturing of test rig and test samples and test execution		210.000	
JTI-CS-2010-3-GRA-02-011	LE based technology structure realisation		150.000	
JTI-CS-2010-3-GRA-02-012	Aero-acoustic design and assessment of a low-noise configuration for a regional aircraft nose landing gear (NLG)		150.000	
JTI-CS-GRA-03	*Area-03 - All electric aircraft*			
JTI-CS-GRA-04	*Area-04 - Mission and trajectory Management*		**330.000**	
JTI-CS-2010-3-GRA-04-003	Advanced avionics equipment simulation		330.000	
JTI-CS-GRA-05	*Area-05 - New configurations*			
JTI-CS-GRC	**Clean Sky - Green Rotorcraft**	**1**	**430.000**	**322.500**
JTI-CS-GRC-01	*Area-01 - Innovative Rotor Blades*			
JTI-CS-GRC-02	*Area-02 - Reduced Drag of rotorcraft*			
JTI-CS-GRC-03	*Area-03 - Integration of innovative electrical systems*		**430.000**	
JTI-CS-2010-3-GRC-03-003	Piezo power supply module		430.000	
JTI-CS-GRC-04	*Area-04 - Installation of diesel engines on light helicopters*			
JTI-CS-GRC-05	*Area-05 - Environmentally friendly flight paths*			
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	**4**	**12.500.000**	**9.375.000**
JTI-CS-SAGE-01	*Area-01 - Geared Open Rotor*			
JTI-CS-SAGE-02	*Area-02 - Direct Drive Open Rotor*			
JTI-CS-SAGE-03	*Area-03 - Large 3-shaft turbofan*		**10.000.000**	
JTI-CS-2010-3-SAGE-03-002	Aeroengine intake technology development		10.000.000	
JTI-CS-SAGE-04	*Area-04 - Geared Turbofan*			
JTI-CS-SAGE-05	*Area-05 - Turboshaft*		**2.500.000**	
JTI-CS-2010-3-SAGE-05-010	Development of a Wasted Heat Regeneration System (WHRS)		1.200.000	
JTI-CS-2010-3-SAGE-05-011	Development of exhaust noise attenuation technologies		1.100.000	
JTI-CS-2010-3-SAGE-05-012	Development of an advanced system for pollutant measurement		200.000	
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	**8**	**4.040.000**	**3.030.000**
JTI-CS-SFWA-01	Area01 – Smart Wing Technology		**2.140.000**	
JTI-CS-2010-3-SFWA-01-023	Design of Robust Shock-Control-Bumps for Transport Aircraft with Laminar-Flow Wings		350.000	
JTI-CS-2010-3-SFWA-01-024	Flight-tests with multi-functional coatings		150.000	
JTI-CS-2010-3-SFWA-01-025	Development of a closed loop flow control algorithm for wing trailing edge flow control including experimental validat		560.000	
JTI-CS-2010-3-SFWA-01-026	Power module using Silicon Carbide technology for DC/DC converter application		480.000	
JTI-CS-2010-3-SFWA-01-027	Deflection and structural health monitoring of composite wing movables driven by smart actuators		600.000	
JTI-CS-SFWA-02	Area02 – New Configuration		**1.900.000**	
JTI-CS-2010-3-SFWA-02-007	Wind Tunnel Model Design for Low Speed Test with Active Flow Control		250.000	
JTI-CS-2010-3-SFWA-02-008	Numerical and experimental aero-acoustic assessment of installed Counter Rotating Open Rotors (CROR) power plant		200.000	
JTI-CS-2010-3-SFWA-02-009	Model design & manufacturing of the turbofan configuration for low speed aerodynamic and acoustic tests		1.450.000	
JTI-CS-SFWA-03	Area03 – Flight Demonstrators			
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	**13**	**7.250.000**	**5.437.500**
JTI-CS-SGO-01	*Area-01 - Definition of Aircraft Solutions and explotation strategies*		**0**	
JTI-CS-SGO-02	Area-02 - Management of Aircraft Energy		**4.500.000**	
JTI-CS-2010-3-SGO-02-019	Sample PEM construction for testing, characterisation and manufacturability assessment.		500.000	
JTI-CS-2010-3-SGO-02-020	Development of key technology components for high performance electric motors		250.000	
JTI-CS-2010-3-SGO-02-021	Development of key technology components for high power-density power converters for rotorcraft swashplate		250.000	
JTI-CS-2010-3-SGO-02-022	Fan noise reduction : study and realisation of a sub-assembly dedicated to new generation of Starter / Generator		200.000	
JTI-CS-2010-3-SGO-02-023	Development of current and voltage sensors suitable with aircraft environment		600.000	
JTI-CS-2010-3-SGO-02-024	Test bench for endurance test and reliability of avionics power electronic modules		800.000	
JTI-CS-2010-3-SGO-02-025	Definition and realisation of a field bus suitable for a multi-PEM (power electronic modules) ressource		500.000	
JTI-CS-2010-3-SGO-02-026	Modelica Model Library Development Part I		300.000	
JTI-CS-2010-3-SGO-02-027	Simulation and Analysis Tool Development Part I		400.000	
JTI-CS-2010-3-SGO-02-028	Support to design and test of cooling technologies		350.000	
JTI-CS-2010-3-SGO-02-029	Tests of advanced lubrication equipment		350.000	
JTI-CS-SGO-03	*Area-03 - Management of Trajectory and Mission*		**750.000**	
JTI-CS-2010-3-SGO-03-008	Modeling of weather phenomena to support Advanced Weather Radar development		750.000	
JTI-CS-SGO-04	*Area-04 - Aircraft Demonstrators*		**2.000.000**	
JTI-CS-2010-3-SGO-04-001	Design and manufacture of an aircraft tractor compliant with specifications for Smart Operations on ground		2.000.000	
JTI-CS-SGO-05	*Area-05 - Aircraft-level assessment and exploitation*		**0**	
JTI-CS-TEV	**Clean Sky - Technology Evaluator**	**0**		
		topics	VALUE	FUND
	totals (€)	**34**	**25.800.000**	**19.350.000**

Thresholds:

As indicated in section 4.6 of the *"Rules for Participation and Rules for Submission of Proposals and the related Evaluation, Selection and Award Procedures"*, each proposal will be evaluated on 6 criteria.

For a Proposal to be considered for funding, it needs to pass the following thresholds:

- **Minimum 3/5** score for each of the 6 criteria,
  AND
- **Minimum 20/30 total score**

Only one Grant Agreement (GA) shall be awarded per Topic.

Calendar of events:

- **Call Launch: 30 April 2010**
- **Call close: 20 July 2010, 17:00**

- Evaluations (indicative): 13-17 September 2010

- Start of negotiations (indicative): 01 November 2010
- Final date for signature of GA by Partner: 15 December 2010
- Final date for signature of GA by Clean Sky JU: 20 December 2010

Contacts:
All questions regarding the topics published in this Call can be addressed to:

info-call-2010-03@cleansky.eu

Questions received until **20 June 2010** will be considered.

Questions having a general value, either on procedural aspects or specific technical clarifications concerning the call topics, when judged worth being disseminated, will be published in a specific section of the web site (www.cleansky.eu).

All interested applicants are suggested to consult periodically this section, to be updated on explanations being provided on the call content.

Clean Sky Joint Undertaking
Call SP1-JTI-CS-2010-03
Eco Design

Clean Sky – EcoDesign

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
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JTI-CS-2010-3-ECO-01-005	Integration development of a wireless strain monitoring system with a simulation tool		250.000	
JTI-CS-2010-3-ECO-01-006	Enhanced local heating device capable of high and homogeneous temperature for the repair of large composite damages		220.000	
JTI-CS-2010-3-ECO-01-007	Accelerated fatigue testing methodology for fiber reinforced laminates for aircraft structures		200.000	
JTI-CS-ECO-02	*Area-02 - EDS (Eco-Design for Systems)*			

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-ECO-01-004	**Development and implementation of Magnesium sheets in A/C**	End date	*To+24 (June 2012)*
		Start date	*To (June 2010)*

1. Topic Description

Introduction

The development of Magnesium technologies will contribute to the synthesis of an aviation / industry / academy consensus point of view on Magnesium concepts and technologies in the field of aircraft (a/c) parts, and will bring potential improvements towards the Clean Sky objectives, such as:

- Weight reduction
- Cost reduction
- Reduction in energy and fuel consumption
- Efficiency improvements
- Use of fully recyclable materials
- Excellent castability
- Excellent strength to weight ratio
- Lowest energy for machining from all structural metals
- Excellent damping capacity

Improvement of one of these factors will not be offset by degradation of other factors. The improvement will be evaluated and quantified with application to generic small parts of small size business jets (up to airliner size), and with application to future airliners, future business jets and future helicopters.

The objectives of this call for proposal are to develop, produce and approve Magnesium for aircrafts after answering all aviation criteria and requirements. Selected demonstrators will be tested and will suggest the designers to reconsider installation of Magnesium parts in aircrafts.

Achievement of the objectives above shall be done by design new tools, test a new Magnesium sheet alloy, apply a new coating method and perform mechanical and corrosion tests.

Work to be performed by the partners

- Design and manufacture tools with heating bodies in accordance to ITD Topic Leader's drawings (heating bodies shall heat up to 350°C and can be controlled by the operator).
- Produce selected demonstrator part by sheet-forming technologies (Super Plastic Forming or Rubber Pad Forming – as required).
- Perform joining by welding and riveting, and send samples to ITD Topic Leader that will examine the mechanical and the galvanic corrosion properties.

2. Special skills, certification or equipment expected from the applicant

The partner shall have a rich experience in development and implementation of Magnesium technologies including suitable surface treatment for the aviation industry, familiarity with European consortiums and with FAA, JAA and REACH regulations. The partner shall have the ability to pre-design using Finite-Element-Modeling (FEM) and provide the minimum size and thickness of sheet metal, design and manufacturing special tools and dies with controlled heating bodies inside (working temperature required is up to 350°C). The partner shall have the ability to form Magnesium by deep drawing and/or super plastic forming (SPF) and/or bending and/or rubber-pad forming, work with accurate machining (CNC with 3-5 axes), welding ability, laser cutting and pressing machine (up to 1000T).

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
212-01-03-D1	Tools and parts design by Finite-Element-Models (FEM) and tools manufacturing	Design and manufacture tools with heating bodies that will be in accordance to ITD member's drawings. Outputs shall be presented as tools that can be used in the production line.	To+6
212-01-03-D2	Sheet forming by: - Bending - SPF - Rubber-Pad	Investigate the preferred parameters that will represent best the demonstrator parts (by three parameters: time, temperature and press). Outputs of the deliverable shall be the production of the selected demonstrator parts by pressing machine.	To+12
212-01-03-D3	Mechanical testing – Technical report	Perform Static, dynamic and microscopic examination of selected alloys and parts three times: 1. During initial testing to evaluate the properties. 2. During examination of the effect of the forming investigation of parameters. 3. During estimation of the properties of the alloy after selected forming parameters before coating and painting.	To+12
212-01-03-D4	Joining and testing – Technical report	Joining by riveting and welding (joining of Mg-Mg and Mg-Al). The outputs shall be the evaluation and testing of the mechanical, corrosion and galvanic corrosion properties due to the joining types.	To+16
212-01-03-D5	Conductive coating – Technical report	Adapt conductive coating and perform corrosion testing. Output shall demonstrate that no corrosion of any type will be found under ITD member's requirements.	To+24

4. Topic value (€)

The total value of biddings for this work package shall not exceed

€ 70.000,--
[seventy thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program.

5. Remarks

The TRL will be monitored to reach stage 6.

In order to be selected, concepts and technology must show <u>at least</u> one real part of one of business jets, mid-size airliner or rotorcraft.

Clean Sky Joint Undertaking
JTI-CS-2010-3-ECO-01-005

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-ECO-01-005	**Integration development of a wireless strain monitoring system with a simulation tool**	**End date**	*T0 + 18*
		Start date	*T0*

1. Topic Description

1.1 Introduction

Advanced composites are used in many structural applications ranging from aerospace to automotive and infrastructures. Traditionally, most composite properties are generated with coupon testing. These properties are influenced by many factors such as: thickness, manufacturing defects (including voids of different sizes, locations and shapes), and environmental conditions including temperature and moisture. Furthermore, the composite behaviour exhibits significant scatter due to variability in constituent properties. The need exists to monitor the health of large scale structures (i.e. wing of aircraft) with advanced sensing technology to perform live measurement of full field strain data under service loading. This measurement will enable the assessment of the structure based on as built not as designed. Full-field strain data can be correlated with potential damage and fracture of the structure by evaluating pertaining physics based failure criteria. An innovative full-field composites strain detection system, durability and damage tolerance capability with wireless sensor network (WSN) shall measure the strain and assess the health of the structure. The system's RF sensors shall detect composites deformation effectively and efficiently in real-time at early stages. Each sensor module in the system shall consist of off-the-shelf strain gauges and of a battery operated miniature radio for autonomous operation. The strain data shall be used to detect all categories of damage including those that may go undetected by field inspection methods and those that depict damage initiation and growth to fracture.

The technical objective of the proposed work is to develop a methodology and demonstrate the feasibility for a full field strain measurement system. This shall include developing/enhancing and demonstrating a low-cost wireless network ZigBee sensor system, a data-linked progressive failure analysis finite element analysis software system, and a data-linked full-field stress/strain mapping software module.

1.2 Background

The use of full-field strain measurement techniques could reduce costly experimental programs through better understanding of material behaviour. Since the mechanisms of composites failure, especially during cyclic loading, are not well understood, the traditional approach to certify composite aircraft structure requires large numbers of coupons to validate the performance of the composite. This proposal shall have to integrate the structure strain sensor and the IEEE 802.15.4 (ZigBee) based flexible wireless protocol. Using a software like GENOA, a leading edge technology in the fields of composites, structures and efficient computing sciences, shall deliver unequalled ultra-rapid performance and analytical capability directly into the hands of today's engineers. The wireless technology shall use off-the-shelf electronic components with an intelligent controller allowing users to select type of analysis required. Coupling full-field strain measurements with stress models (analyses) shall result in accurate stress-strain relations and material failure criteria with nonlinear effects. The new method shall speed up the entire process by using the off-the-shelf Wireless Sensor Network (WSN), a system of sensors and wireless controllers to monitor/detect wider area strain, to process the data quickly and communicate the result to a PC. By lowering the cost to validate the use of composite materials, the barriers to implementation of new materials, analysis methods, and structural concepts shall be reduced. The developed technology shall effectively contribute to enhanced structural reliability through the on-board monitoring of strain data coupled with analytical simulation of the structure under service loading. With the newly developed technology it shall be possible to take corrective actions including structural repair to prevent catastrophic failure events of aircraft components.

1.3 Scope of work

The scope of the work is the enhancement of a hardware/software system solution comprised of; 1) multi-scale (micro-macro) progressive failure composite durability and damage tolerance (D&DT) software, and 2) small cell phone size radio frequency (ZigBee) wireless strain measurement hardware unit. The software utilization shall exercise the FAA recommended building block verification strategy, FAA 5 damage tracking categories, and ASTM validation procedure (from lamina to laminate to notched, to sub-element to element and all the way to component). The proposed method enables significant reduction of testing. The method can evolve to on-board or on-line health monitoring of large scale structures by evaluating full strain field data.

1.4 Type of work

The work involves monitoring health condition of aircraft structures. It does involve modelling, analysis, simulation, manufacturing (installation of gauges and sensors), data transmission, data collection, and data processing from physical structures.

1.5 Schedule, milestones and deliverables

Task 1 – Develop ZigBee Sensor System Interface into Software

The parameters of ZigBee sensor system shall be defined to be used in the demonstration. The parameters under consideration shall be: 1) Distance of Zigbee from the lead mount from the surface of composite, 2) Adhesive bond type, 3) Conflict between the signals received from different Zigbee units representing different IP addresses, 4) Temperature compensation and 5) Noise effect on the strain signal. Debug and laboratory test of the ZigBee sensor system-to- data interface software shall be performed.

Deliverables:

1) ZigBee sensor system parameters and their effect on strain signal processing;

2) ZigBee/GENOA interface software;

3) Lab report for ZigBee/GENOA interface demonstration.

Start: T0

End: T0+4 months

Task 2 - Develop Full Field Strain Mapping Interface Software

Debug and laboratory test the Far Field Strain Mapping interface software shall ensure that the data flow to and from GENOA to the Mapping software corresponds to each program's input/output formats in the desired time sequence and time interval. Advanced interpolation routine and surface mapping, error checking algorithms, and Java based visualization will be incorporated into the mapping of strain gage data to update the finite element model (FEM), and progressive failure analysis (PFA) results to compute the strain distribution. The methodology shall be based on isoclinic photoelastic interpolation with system identification to minimize the errors between the true strain distribution and the computed interpolation.

Deliverables:

1) Far Field Strain Mapping Software;

2) Data interface software between GENOA and Far Field Strain Mapping Module;

3) Lab report for Far Field Strain Mapping interface demonstration

Start: T0

End: T0+6 months

Task 3 – Selected Hardware and Instrumentation Layout

Advanced composite specimens or subcomponents shall be selected and provided by ITD member as test articles for Task 5 System Demonstration.. A PFA-based FEA of the test specimens shall be performed. Three different loading conditions shall be addressed. These shall be limited to Design Limit Load to preclude failure or damage to the component. Predicted far field stress/strain maps shall be extracted from the model output. A ZigBee sensor system shall be laid out for the selected advanced composite component, based on the FEA, to optimally define the strain distributions.

Deliverables:

1) Predicted stress/strain distributions for selected advanced composite component;

2) ZigBee sensor system layout for the selected component.

Start: T0

End: T0+10 months

Task 4 – Finalize ZigBee Sensor System Hardware and Install on the Component (s)

In Task 4, the design, fabrication and checkout of the ZigBee sensors used on the selected ITD member components shall be completed. The installation and performance of the ZigBee sensors on the components shall be performed. The location of the ZigBee strain sensor mount shall be determined from the PFA software, as the critical damage occurrence.

Deliverables:

1) ZigBee sensors to be applied to the selected component;

2) Selected advanced composite component will installed ZigBee sensor system;

3) Determine multi-sensor locations.

Start: T0

End: T0+ 14 months

Task 5 – Demonstrate ZigBee/ Full Field Strain Mapping System

The selected advanced composite test articles, with the ZigBee sensors installed shall be mounted in an available test rig. The Far Field Strain Mapping software systems shall be physically interfaced to the ZigBee system.

System operation checkouts shall be performed to ensure complete system operation. The three test loading conditions evaluated in Task 3 will be applied to the selected component, one case at a time. Loads shall be kept under Design Limit load to preclude damage or failure to the component. The proposed far field strain mapping system shall be exercised for reach loading condition. Test results shall be compared to the Task 3 predicted far field stress/strain distributions.

Deliverables:

1) Lab report documenting the selected component testing;

2) Report comparing the predicted far field strain distributions and the test results.

Start: T0

End: T0+18 months

For each task, a technical report shall be prepared to describe in detail the activities performed and summarize relevant achievements.

2. Special skills, certification or equipment expected from the applicant

Knowledge in state of the art sensor and strain gauges technology, data streaming, data collection and processing, progressive failure analysis, finite element analysis, computational mechanics, composite mechanics, composite failure theories, modeling and sizing of aircraft structures, and structural health monitoring.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Develop ZigBee Sensor System Interface Software	1) ZigBee / GENOA interface software 2) Lab report - ZigBee / GENOA interface demonstration	T0+4 months
D2	Develop Full Field Strain Mapping Interface Software	1) Far Field Strain Mapping Software 2) Data interface software between GENOA and Far Field Strain Mapping Module 3) Lab report - GENOA/Far Field Strain Mapping interface demonstration	T0+6 months
D3	FEA of Selected Hardware and Instrumentation Layout	1) Predicted stress/strain distributions for selected component 2) ZigBee sensor system layout for selected component	T0+10 months
D4	Finalize ZigBee Sensor System and Install on Selected Test Component	1) ZigBee sensors for selected component 2) Selected component with installed Zigbee sensor system	T0+14 months
D5	Demonstrate ZigBee/ Full Field Strain Mapping System	1) Laboratory Test Report for selected component 2) Test report showing comparison of predicted vs. test results	T0+18 months

4. Topic value (€)

The total value of biddings for this work package shall not exceed

€ 250.000,--
[two hundred fifty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program.

5. Remarks

If applicable

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-ECO-01-006	**Enhanced local heating device capable of high and homogeneous temperature for repair of large composite damages.**	End date	*To +18 (31/12/2011)*
		Start date	*To (01/07/2010)*

1. Topic Description

1.1. Composite repair background

Highly loaded nacelle composite parts with severe damages can be repaired :

- using **of bolted repairs** that restore structural capability but have impact on nacelle performance such as weight, acoustic, aerodynamics,…reducing in some case the scope of application (aerodynamic surface for exemple),
- using **composite process.**

In this case, state-of-the-art composite repairs use autoclave for curing, which lead to energy consuming and complicated repairs because the curing requires high temperatures (about 250°C). So to be repaired the damaged part must be removed from the assembly to avoid damaging the surrounding parts. The **disassembling and assembling** of the parts for each repair are a **heavy maintenance burden** in terms of time, fastener and material consumption and thus high cost. The results of such costly repairs lead to **the replacement of many damaged parts**.

1.2. Objectives of the project

A potentiel process to improve state-of-the-art process, is to cure composite using local heating devices in place of autoclaves; but standard local heating devices do not allow the **local repair** of damages on composite parts because they **do not meet all the required technical specifications**. The limitations of these devices can be:

- Incapacity to work under pressure
- Lack of accuracy: no homogeneous temperatures (standard: +/- 30°C)
- Not reliable: no performance guaranty
- Impossibility to work at high temperatures
- Incapacity to heat important area (standard: 700x700mm)

This means there is an important need for a **local** heating device to repair composite aeronautical parts in order to facilitate or even make possible the repair of composite damages. This local device shall allow the cure of composite repairs involving medium to high temperature resins **with technical specifications that meet autoclave ones**. With such a device one should be able to reduce repair costs, wastes and energy consumption.

Furthermore, in order to certify **structural bonded repairs** for severe damages there is a need for an enhanced heating device that fulfils the following requirements: capability to restore full strength, stiffness and damage tolerance. In term of heating device this means the **need for highly reliable, accurate, monitored and local devices** and result in an enhanced heating device that meets the following requirements:

- Capacity to work under pressure (0.7 to 10 bar)
- Highly accurate: homogeneous temperature with low tolerance (+/- 5°C on the whole repair area)
- Process monitoring: direct control of process parameters (temperature, time)
- Reliable: performance guaranty
- High temperature (about 250 °C)
- Capacity to heat wide area (up to several m²)

This innovative device will allow performing structural repairs without the traditional autoclave/oven high energy consumption, bringing the following improvements:

- No disassembling / assembling of the parts, reduce the maintenance burden
- Less fasteners / material consumption
- Less energy consumption
- Surrounding structures of the damaged area are not impacted
- More parts can be repaired which means less waste
- Reliable process (monitoring and reproducibility)
- Optimized process (reduction of the curing cycle)

1.3. Scope of work

A preliminary research made by ITD Topic leader leaded to the conclusion heating blanket is the most likely technology to achieve the objectives. Since state-of-the-art heating blankets are limited to cosmetic repairs due to their poor performances, the scope of the work is an enhancement of the standard heating blankets and optimization of the curing cycle.

The expected equipment should be compatible with all standard aeronautic composite parts shapes, including monolithic and sandwich parts.

1.4. Schedule and major deliverables

Preliminary task: Preliminary testing of state of the art heating blankets

This task is performed by ITD Topic leader. It consists in testing and characterizing a wide spectrum of existing heating blankets to precisely establish what improvement must be performed. A report will be provided by ITD Topic leader to the partner.

Task 1: Preliminary solutions and test plan

The partner must develop a preliminary solution and associated test plan. ITD Topic leader will provide to the partner composite repair requirements (standard composites repair requirements).

Deliverables 1 and 2.

Task 2: Local heating device prototypes delivery

The partner must develop a functioning heating device prototype with the associated performance goals that must be above the requirements described in paragraph 1.2

Deliverable 3.

Task 3: Testing

The partner will test the prototype in order to demonstrate it fulfils the requirements; he shall optimize and reduce the curing cycle through parametric studies.

Deliverable 4.

Task 4: Industrialization of the enhanced heating blanket

After the testing phase the partner will be in charge of producing ready to use local heating devices with associated user guide.

Deliverables 5 and 6.

2. Special skills, certification or equipment expected from the applicant

Previous experience regarding local heating systems Knowledge of aeronautical environment and composite repair

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
1	Preliminary solutions presentation	Document: Preliminary test results, description of the preliminary solution	T0+ 3 month
2	Test plan	Document: Description of the tests to be performed, expected results	T0+ 3 month
3	Local heating device prototype delivery	First functioning heating device prototype with performance goals	T0+ 6 month
4	End of tests	Document: Test report showing all the test results and achieved performances	T0+ 15 month
5	Local heating device final delivery	End of development – heating device ready to use with performance charts	T0+ 18 month
6	User guide	Document: working range, field of intervention, serviceable parts	T0+ 18 month

4. Topic value (€)

The total value of biddings for this work package shall not exceed

€ 220.000,--
[two hundred twenty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program.

5. Remarks

IPR shall be dealt with applicable documents to partners under FP7 as per Grant Agreement for Partners and Implementation Agreement (ftp://ftp.cordis.europa.eu/).

Topic Description

Topic Nr.	Title		
JTI-CS-2010-3-ECO-01-007	**Accelerated fatigue testing methodology for fiber reinforced laminates for aircraft structures – development and validation**	**Start Date**	To
		End Date	To+36

1. Topic Description

The **objective** of this call for proposal is the development and validation of an advanced testing methodology for predicting the long-term fatigue life of multi-ply tape laminates for the use in aircraft structures.
The methodology shall be developed based on an approach to accelerated lifetime predictions of carbon fiber reinforced laminates, which is already known to the applicant (e.g., from open literature) and whose general feasibility has already been demonstrated experimentally by the applicant. The development will expand the existing approach systematically such that the number of structural configurations, load conditions, and environmental effects covered and accounted for by the testing methodology is increased by the following **technical achievements**:

- Multi-ply approach: The fatigue model will be able to predict the lifetime of structures made of different stacks out of a specific set of plies instead of only being applicable to the specific stack configuration of the validation test specimen.
- Multi-axiality: The fatigue model will be able to predict the lifetime of the laminate structures exposed to complex load situations simultaneously combining several contributions like tensile, shear, and torsion modes instead of only covering one uniaxial loading mode.
- Humidity: The fatigue model will be able to predict the lifetime at arbitrary levels of humidity instead of only being valid for one particular moisture level.

The outcome of the investigation will be an Excel spread-sheet table that allows accounting for all abovementioned effects.

The development work will consist of experimental tests, physical analysis, and numerical simulation. The experimental tests will specifically be designed and performed as required by this development work starting from specimen fabrication out off material samples provided by the partners of the Clean Sky ED-ITD.
The *experimental tests* shall include single mode as well as combined tests providing for a comprehensive characterization of the material behavior with respect to its temperature dependent static, transient, dynamic and fatigue contributions. The tests will be performed by state-of-the-art equipment supplemented by in-situ contact-less measurement features applying digital image correlation, DIC, that allows a precise quantification of the multi-dimensional stress and strain fields occurring in the specimen during tests.
The *physical analysis* will include destructive and non-destructive techniques providing thorough information on the microstructure of the specimens at all stages of the tests. All experimental data, i.e., the static and the transient data of the stress and strain fields as well as the micro structural information, will be captured by parametric 3-D finite element models and each test will be replicated by a *numerical simulation* at all its phases - including the failure of the sample if applicable. Hence, concepts of fracture and damage mechanics shall be applied besides those of nonlinear continuum mechanics. By means of closed loop combination of experimental tests, physical analyses, and numerical simulations, all effects shall be studied and analyzed thoroughly that contribute to the fatigue life of aircraft structures made of the material under investigation even in configurations not tested explicitly (i.e., in different stack configurations).
The validity of each methodology enhancement shall be demonstrated.

Milestones
Methodology enhancement with respect to humidity effects (developed and validated).

Methodology enhancement with respect to multi-ply effects (developed and validated).
Methodology enhancement with respect to multi-axiality effects (developed and validated).

2. Special Skills, certification or equipment expected from the applicant

- The applicant should have a strong background in mechanics and characterization of composite materials.
- The applicant must have a rich experience in numerical simulations of advanced materials, nonlinear finite element analyses, fracture mechanics and damage mechanics.
- The applicant must have all means in hand to satisfy the abovementioned requirements. Specifically, the applicant must have:
    - a material characterization lab with sample preparation workshop, universal and DMA testing equipment for all test modes mentioned in the task description featuring temperature chambers (-55°C to 200°C) providing for moisture control (up to 85%r.h.) and in-situ optical inspection
    - a lab for comprehensive physical failure and material analyses (complete set of materialographic tools and microscopes: e.g., optical, ultrasonic, X-Ray, SEM with EDX etc.) and for non-destructive techniques
    - tools and methods for in-situ contact-less multi-axial strain measurement by digital image correlation
    - all hardware and software tools for 3-D numerical simulation by techniques including FEM and X-FEM that allow automatic process control based on the full set of statistical and stochastic routines (for parameter identification, sensitivity analysis, robustness analysis, optimization etc.)

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Feasibility Report	Demonstration of the feasibility of the tests, the physical analysis, and the numerical simulation according to the *preexisting* methodology based on material samples provided by the partners within CS ED ITD	T0+6 month (30.06.2011)
D02	Report on validation of concept	Demonstration of the feasibility of the concepts developed for expanding the methodology towards including the effects of humidity, multi-ply, and multi-axiality effects	T0+12 months (31.12.2011)
D03	Humidity expansion report	Methodology enhancement with respect to humidity effects is developed and validated	T0+24 months (31.12.2012)
D04	Multi-ply expansion report	Methodology enhancement with respect to multi-ply effects is developed and validated	T0+30 months (30.06.2013)
D05	Final report	Methodology enhancement with respect to multi-axiality effects is developed and validated and project closure	T0+36 months (31.12.2013)

4. Value of CfP workpackage

The total value of biddings for this work package shall not exceed

€ 200.000,--
[two hundred thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program.

5. Estimated spend profile

2009	2010	2011	2012	2013	2014	2015
0	0	70	70	60	0	0

6. Remarks

Clean Sky Joint Undertaking
Call SP1-JTI-CS-2010-03
Green Regional Aircraft

Clean Sky - Green Regional Aircraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	**4**	**840.000**	**630.000**
JTI-CS-GRA-01	*Area-01 - Low weight configurations*		**0**	
JTI-CS-GRA-02	*Area-02 - Low noise configurations*		**510.000**	
JTI-CS-2010-3-GRA-02-010	Advanced concepts for trailing edge morphing wings: design and manufacturing of test rig and test samples and test execution		210.000	
JTI-CS-2010-3-GRA-02-011	LE based technology structure realisation		150.000	
JTI-CS-2010-3-GRA-02-012	Aero-acoustic design and assessment of a low-noise configuration for a regional aircraft nose landing gear (NLG)		150.000	
JTI-CS-GRA-03	*Area-03 - All electric aircraft*			
JTI-CS-GRA-04	*Area-04 - Mission and trajectory Management*		**330.000**	
JTI-CS-2010-3-GRA-04-003	Advanced avionics equipment simulation		330.000	
JTI-CS-GRA-05	*Area-05 - New configurations*			

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-GRA-02-010	Advanced concepts for trailing edge morphing wings: design and manufacturing of test rig and test samples and test execution	**Start date**	T_0
		End date	T_0+6**

1. Topic Description

Acronyms

DESA: Deeply Embedded Smart Actuators

HW: Hardware

RP: Report

SACM: Smart Actuated Compliant Mechanism

SMA: Shape Memory Alloy

Short description

The Deeply Embedded Smart Actuators (DESA) is an actuation architecture aimed at producing camber variations on the aft part of the wing, thus modifying (i.e. increasing) lift ability.

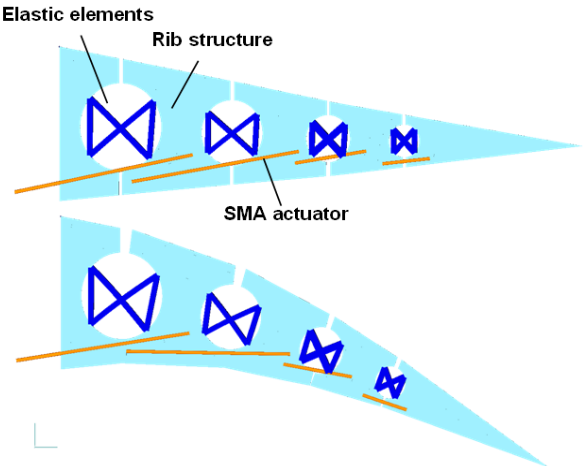


Fig.1. Conceptual scheme of DESA.

The conceptual scheme of aforementioned architecture is reported above. Shape modification is enforced by SMA elements (rods, ribbons, wires,…), actuated by heating, through Joule effect (electric working).

When cooled, the structure elastically reverses to its original shape. SMAs and elastic components are also "load-bearing" elements. SMAs have also to be pre-loaded to accomplish their working ability.

This "smartflap" has been conceived to be integrated within a regional aircraft. Dimensions: 70 cm chord, 1m span.

1.1 Introduction

1.1.1 Background

The task is related to the support of GRA Low Noise Configuration

A preliminary design of DESA architecture will be available. In addition, being required the design of a test rig for subsequent characterisation of both DESA and SACM, also the preliminary design of this latter one will be provided.

The document containing these information jointly with requirements for testing (i.e. loads specifications for several flight conditions, expected performance in terms of trailing edge vertical *displacement, camber increase and so on) will represent the input of this CfP.*

The proposed work is a crucial activity within the ITD; as a matter of fact, it envisages the realisation of DESA lab demonstrator and the execution of related experimental tests on both DESA and SACM, contributing either to validate numerical predictions and to highlighting eventual deviations.

1.2 Reference documents

Not Applicable

1.3 Scope of work

The main objective of the CfP is the experimental characterisation of SACM and DESA morphing prototypes. Different intermediate objectives will be addressed to achieve the final target:

1) an executive design assumed as base for the manufacturing process, will be carried out, having as result DESA demonstrator executive drawings

2) a tailored manufacturing procedure will be defined and implemented to realise DESA prototype, as from executive drawings specifications

3) to assure the characterisation of SACM and DESA demonstrators and the validation of numerical schemes used during design phase, a suitable test rig will be defined and assembled

4) a detailed test plan will be filled in, by taking into account the different tests that will be executed, for several external loads, depending on the operative conditions the prototypes are supposed to work (i.e. cruise, take-off, landing regimes)

5) a test campaign will be performed on the base of abovementioned test plan; obtained data will be used as reference for validating numerical predictions and for estimating prototype real performance for several load conditions.

1.4 Type of work

The main objective of aforementioned CfP is the realisation of DESA architecture and the experimental characterisation of it and of another architecture, Smart Actuated Compliant Mechanism (SACM). To this aim, the following activities will be finalised:

Task1: Advanced design of DESA architecture (see Fig.1), providing for all manufacturing aspects (material choice, interface problem among the several components, and so on); the output of this activity will be the executive drawings of DESA, considered as reference for subsequent manufacturing task.

Task2: In view of the next experimental activities, a dedicated test rig and related interface component will be designed and then assembled; this test rig, shown in Fig.2, will allow for testing under several operative conditions (loads for several mission phases like take-off / landing, cruise), contemplated in the test plan, previously edited within the same CfP.

Task3: Basing on mentioned DESA executive drawings, the manufacturing will be finalised and a preliminary functionality test will be carried out, thus assuring the correct working; during this phase, also the pre-compression status of the springs will be set.

Task4: Finally, DESA and SACM architectures (the SACM architecture will be delivered with the same DESA interface, thus allowing for its integration within the test rig) will be mounted on the test rig and the experimental characterisation under static loads and dynamic excitation will be performed.

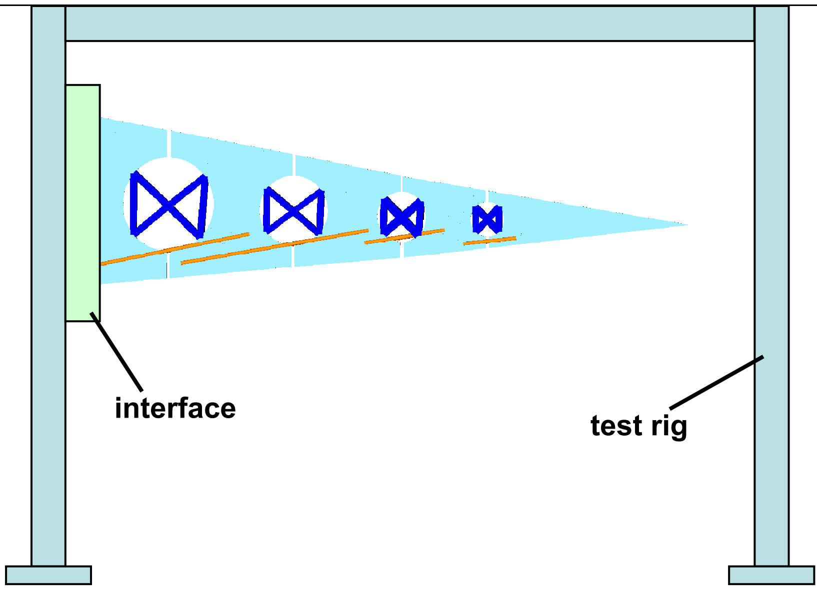


Fig.2. Test rig and interface.

1.5 Requirement
Not Applicable

1.6 Other
Not Applicable

1.7 Schedule, milestones and deliverables:

Milestone	Description (if applicable)	Due date**
M1	DESA architecture advanced design ready for manufacture	T0+2
M2	DESA prototype manufactured	T0+5
M3	Test rig design ready for manufacture	T0+2
M4	Test rig manufactured	T0+5
M5	SACM and DESA experimental results available	T0+6

2. Special skills, certification or equipment expected from the applicant

Background in:

- Mechanical design,
- CAD,
- Experimental characterisation of lab structural prototypes;
- Measurements of displacement, strain, loads, eigenfrequencies and eigenmodes

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date**
D1	RP: executive drawings of DESA lab demonstrator	A document describing and containing the executive drawings of DESA demonstrator, produced in task T1	T0+2
D2	HW: DESA prototype	This prototype is the output of task T3	T0+5
D3	RP: Test rig executive drawings	A document describing and containing the executive drawings of test rig, produced in task T2	T0+2
D4	HW: Test rig available for test	This test rig is the output of task T2	T0+5
D5	RP: SACM and DESA experimental results	A document describing and containing the experimental results produced in task T4	T0+6

4. Topic value (€)

The total value of this work package shall not exceed:

210,000.--€

[Two hundred and ten thousand euro]

Please note that VAT is not applicable in the frame of the CleanSky programme

5. Remarks

If applicable
** T_0 and duration may be negotiated on the basis of the final JU time slots.
Projections from Deliverable D1 may allow duration to increase by up to 3 months if status of WP2213 allows this.

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-GRA-02-011	LE based technology structure realisation	**Start date**	*To***
		End date	*To +18-***

1. Topic Description

Provide a **partial structural concept for the Leading Edge(LE)** of a regional aircraft in terms of **a mockup** to bench mark and help linearize the forced response of the leading edge.

Today more advanced concepts are being trusted to produce a structurally induced deflection of the leading edge of an aircraft wing in order to finely tune the high lift performance without using slats or Krueger devices which mean more parts to handle with.

Especially, if active material were used to droop the nose down and somewhat forward a key problem arises: the active linearized behaviour of the whole setup has to be researched and simplified to the point that meaningful reference control surface input can be defined. Furthermore, the modern regional aircraft wing presents a **very slender integration geometry**.

Whereas multidisciplinary consortial work is already forthcoming on the aerodynamic and aeroacoustic boundary conditions under active deployment, the highlight here is to research a **basic reference LE structure topology.**

For this the following approach should be proposed and delivered.

I) A 2D structural part in closeness to the LE outline, inclusively with a meaningful leading edge spar that would serve as a mounting element too. The rough dimensions are given further down.

II) A calculated conjecture of the rib realisation that is to be used in the delivered 2D structural part, with also a view to an idealised compliance test to be conducted.

Proportion of effort?

For I) one is not specific about the material, it could be "just" aluminium folded plate or milled or composite realization; for II) it is not necessary to propose a full blown commercial topology optimisation, if experience values and effective drawing/analytic assumptions of the main parts can out rightly and transparently control the design. A certain amount of "realistic imagination" is left open to the proposer in contention to innovatively and seriously approach this matter within the budget using his abilities.

Basic geometry

This **in-plane 2D basic structure** shall measure from nose tip to "dummy" front spar roughly 0,8metres. At the spar vicinity a height of roughly 0,2 metres is only given. The radius of the nose tip is roughly 0,05 metres.

Further necessary information will be decided in the negotiation: the exterior aerodynamic, and forced displacement load and how it would be imparted, the perceived deflection under this load of the nose.

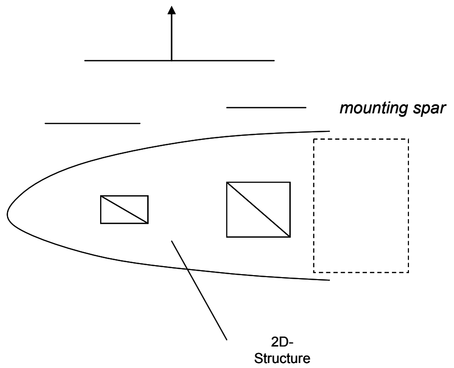
It is clear, that a **non-trivial web or truss structure** within the boundary plating must be conceived. The back up spar may need special compliance design to allow some behaviour tuning.

Weight and parts

The weight penalty of this compacted 2D structure will be accounted. No. of parts, their shelf weight, then total weight of the LE structure measured.

Compliance test

Finally, mounted on spar, the part will be tested to at least a third of the in-plane linear load at which the structure may tip over and or buckling occurs. Depending on the partner capability this non-fuss but accurately followed test can be conducted at the partner's or member's facilities. Loads, deflection and selected strain will be measured; the exterior load's and internal structural work accounted.



Special nice to have:

If in some part the rib was a truss structure, it would enable the member to introduce an actuator to impart also a benchmark active internal load.

Tasks

T1. With the support of the GRA Member clarify the boundary conditions in order for the partner to derive a short concept description with appropriate 2D sketches within *3months*.

This first matter will include the definition of description/drawing how the deformation takes place. Include at this stage some written out sizing calculations for the most important/ critical structural members, using assumed materials, fittings, joints etc. - taking care of buckling, perceived simple stage test condition.

T2.

Make the 2D leading edge structure and the mounting spar which should have the appropriate bolting, hinges.

Present calculation in view of future test with supporting drawings to agree milestone M**1**: go ahead for test

T3.

Collate mass plan.

Setup and conduct test at member's our partner's facilities (agreed under **T1**)
M**2**: structure mounted and instrumented

T4.

Create final report RC being a compendium of **T1** to **T3** and short synthesis
M**3**: delivered final report.

Reporting
R**A**: Short Report "concept description" for **T1**
R**B, part 1**: includes update of R**A** versus fabricated LE structure and its spar
R**B, part 2**: includes results from **T3**
R**C**: final report, comprises updated R**A** and R**B** parts plus synthesis
(The reports could be seen as a growing single living document but in essence to track and discretize the major tasks and events, this writing is earmarked to concise and transparent content, results but NOT to confer tedious volume)

2. Special skills, certification or equipment expected from the applicant

There is no hardware or upfront tools specification or impingement to use certain commercial tools, yet IF commercial FEM (finite element method) were employed then so called bulk data should be exported to a NASTRAN format and particular structural members indentified/ explained against analysis. Any electronic formats will be decided in the negotiation. Working language will be English.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date**
D1	Short report A	Concept sketch LE structure, spar manufactured and assembled and M**1** (go ahead for test and its steps)	T0+3 T0+10
D2	Report B, part 1	2D structural system mounted, instrumented and ready for Test M**2**	T0+12 T0+13
D3	Report B, part 2		T0+16
D4	Final Report C	One month concise compilation of RA, RB parts including T3 M3: delivery of this report RC	T0 + 18

4. Topic value (€)

The total value of this work package shall not exceed: **150, 000 €** [one hundred and fifty thousand Euro] Please note that VAT is not applicable in the frame of the CleanSky programme.

5. Remarks

*** To and duration may be negotiated on the basis of the final JU time slots.* If the concept is of good use/ promising the Partner may undertake further collaborative activities.

Clean Sky Joint Undertaking
JTI-CS-2010-3-GRA-02-012

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-GRA-02-012	**Aero-acoustic design and assessment of a low-noise configuration for a regional aircraft nose landing gear (NLG).**	**Start date**	*T0*
		End date	*T0+7*

1. Topic Description

Short description

The topic of the present call for proposal is the acoustic optimization of a nose landing gear architecture by using CFD/CAA numerical analyses. A baseline configuration (isolated or with a fuselage installation) will be provided.

Abbreviations & Definitions

CAA	Computational Aero-acoustics
CAD	Computer Aid Design
CFD	Computational Fluid Dynamics
DES	Detached Eddy Simulation
HPC	High-Performance Computing
LES	Large Eddy Simulation
LG	Landing Gear
NLG	Nose Landing Gear
U-RANS	Unsteady Reynolds Averaged Navier Stokes

1.1 Introduction

Aircraft noise is a major issue for the scientific community aiming at reducing the impact of the air traffic pollution in the proximity of airports. Take off and landing airplane configurations generate high level of acoustic disturbances due to propulsion systems, high lift devices (e.g. flaps, slats) and landing gears. After focusing mainly on low noise engines, the attention has been shifted on reducing the airframe noise. High lift devices, aerodynamic brakes, landing gears along with their bays are the major source of airframe noise due to the unsteadiness induced in the flow field. A preliminary numerical study of such complex flows can alleviate a highly-cost experimental work by selecting a reduced number of potentially low-noise configurations to be tested. Particularly challenging is the evaluation of the airframe noise due to landing gears. Indeed, fully three dimensional interactions between small and large scale vortical structures are generated by the various components such as wheel pack, gear strut, brake axles, etc. Thus, numerical tools should be sufficiently sophisticated to capture acoustic-type pressure disturbances on different length scales by using reasonable computational resources.

1.1.1 Background

The geometry of a nose landing gear is a complex assembly of different elements whose shapes and dimensions can be very different each other thus resulting in a very complex configuration. A rough scheme of landing gear includes wheels, axles, brake boxes, a vertical strut and two or more oleo struts. Fairings and pipes are included in a realistic geometry. Where possible a cylindrical shape is adopted for the vertical strut and other components. Phenomena similar to that of a cylinder immersed in a sub-sonic viscous flow can be observed in the proximity for the cylindrical components. In general, extended flow separated regions are visible downstream a nose landing gear with vortical macro structures from the vertical struts and wheels. From smaller components small scale vortices are generated which are convected and diffused downstream. The interaction of macro and micro vortical structures generates complex flow patterns.

One noise source generated by a nose landing gear is a quasi-periodic shedding phenomenon typical of cylindrical geometries immersed in a viscous flow. Other noise sources are the LG bay and cavities between the brake and wheels. Moreover, the noise generated by the interaction of different sources and the reflections of pressure fluctuations on the fairings and/or the fuselage play an important role.

In the past years different CFD/CAA methods have been applied to this kind of flows with the final aim of improving the aero-acoustic behaviour of the landing gear. The modification of some geometrical parts towards more aerodynamic shapes and the addition of fairings are example of possible strategies to reduce the radiated noise. A landing gear has got a rather complex geometrical shape, as a consequence, classical CFD tools, developed for aerodynamic configurations, are often not well suited and difficulties (of different nature) are met in carrying out different steps of the simulation process. CAD modelling, mesh generation, accuracy and cost of the flow simulation are typical difficulties to be overcome.

1.1.2 Interfaces to ITD

Among the objectives of GRA-Low Noise project there is the "Design of a nose landing gear low-noise configuration for a Regional Aircraft".

The baseline configuration CAD definition will be available.

Some design guidelines (requirements, constraints) will be available on how to improve the acoustic behaviour of the baseline configuration.

1.2 Reference documents

N.A.

1.3 Scope of work

The scope of the work to be accomplished by the applicant is the numerical design of a low-noise Nose Landing Gear (NLG) configuration starting from a baseline configuration.

Different activities are required:

1. Study and assessment of the aeroacoustic performance of the baseline landing gear configuration.
2. Definition of concepts/technologies to improve the aeroacoustic performance under some design guidelines/constraints.
3. Assessment of an improved low-noise configuration based on defined concepts/technologies for the nose landing gear.

1.4 Type of work

Numerical analyses are required to asses low-noise solutions, provided some design guidelines.

Methods based on semi-empirical correlations are considered low fidelity methods, and are not recommended.

Among the possible CFD formulations U-RANS and LES are preferred methods; combining different models in different regions is also a viable solution (e.g. DES).

Noise can be propagated to far-field adopting an integral method based on the Ffowcs_Williams & Hawkings (FW-H) acoustic analogy.

Other CAA techniques which take into account for the noise reflection and/or scattering are not mandatory but will be taken into account for the selection of the best proposal.

The numerical simulation activities should include the following steps:

1. Choice of objective function to minimize the NLG noise
2. Preliminary aeroacoustic performance assessment of the baseline landing gear configuration via CFD/CAA simulations
3. CAD design of concepts/technologies to improve the aeroacoustic performance under some

design guidelines/constraints.

4. Aeroacoustic performance assessment of the improved low-noise configurations via CFD/CAA simulations.
5. Choice of the optimal low-noise NLG configuration.

1.5 Requirements :

The baseline configuration of the nose landing gear, the design guidelines and specific requirements and constraints will be available at a later date to the successful applicants.

The applicant should provide some info on previous CFD/CAA experience and on the CFD/CAA tools that will be applied. A brief technical report containing comparisons of results obtained by the applicant CFD/CAA tools with public domain data (if available) is encouraged but not mandatory.

Information about the input/output, file formats, use of standards for the data storing will be released at a later date to the winning applicant.

1.6 Other

N.A.

1.7 Schedule**, milestones and deliverables**

A kick-off meeting, a progress meeting (via teleconference) and a final meeting will be scheduled.

The following critical milestones have been identified:

M1 (T0+2)

Study and assessment of the aeroacoustic performance of the baseline landing gear configuration.

M2 (T0+3)

Definition of concepts/technologies to improve the aeroacoustic performance under some design guidelines/constraints (in agreement with the CfP Topic Manager).

M3 (T0+7)

Assessment of an improved low-noise configuration based on defined concepts/technologies for the nose landing gear.

2. Special skills, certification or equipment expected from the applicant

Due to the technical complexity of the call and to the short duration of the activities, a proved experience of the applicant in the fields of computational fluid dynamics and aero-acoustics will be a key element of the selection.

The applicant is expected to have access to HPC facilities with the necessary computational power.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Preliminary design of a low-noise NLG.	Report containing: - Study and assessment of the aeroacoustic performance of the baseline landing gear configuration. - Definition of concepts/technologies to improve the aeroacoustic performance under some design guidelines/constraints.	T0 (**)+3
D2	Aero-acoustic design of a nose landing gear configuration .Final Report.	Report containing: - Summary of activities already reported in D1 - Noise reduction benefits due to aero-acoustic optimization. - Define guidelines for an experimental assessment of the low-noise NLG concept.	T0+7
D3	CFD database	CFD data base + Report containing: - CFD/CAA test matrix - CFD/CAA data organization - CFD/CAA data format	T0+7
D4	Geometry of the NLG low-noise configuration	CAD model	T0+7

4. Topic value (K€)

The total value of this work package shall not exceed:

150, 000 €

[one hundred and fifty thousand Euro]

Please note that VAT is not applicable in the frame of the CleanSky programme.

5. Remarks

N/A

Clean Sky Joint Undertaking
JTI-CS-2010-3-GRA-04-003

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-GRA-04-003	**Advanced avionics equipment simulation**	**Start date**	*T0 (**)*
		End date	*T0(**)+ 14*

1. Topic Description

Acronyms

A/C	Aircraft
FMS	Flight Management System
GLONASS	Global Navigation Satellite System
GPS	Global Positioning System
GRA	Green Regional Aircraft
ITD	Integrated Technological Demonstrator
SGO	Systems for Green Operations
MTM	Mission Trajectory Management
GPS	Global positioning System
RAIM	Receiver Autonomous Integrity Monitoring
PRAIM	Predictive RAIM
TCP/IP	Transmission Control Protocol/Internet Protocol
UDP	User Datagram Protocol
FMS	Flight Management System
SS	System Specification
WBS	Work Breakdown Structure
WP	Work Package

Short description:

Object of this Call for Proposal is the development of a simulated Global Position System (GPS). The GPS is a satellite-based radio navigation system, which broadcast a signal that is used by receivers to determine precise position anywhere in the world. The receiver tracks multiple satellites and determine the user location. A minimum of four satellites is necessary to establish an accurate three dimensional position. Every satellite's orbital parameters (ephemeris data) are sent to each satellite for broadcast as part of the data message embedded in the GPS signal. The GPS coordinate system is the cartesian earth-centered earth fixed coordinates as specified in the World Geodetic System 1984 (WGS-84).

1.1 Introduction

1.1.1 Background:

GRA ITD WP4 deals with Mission and Trajectory Management (MTM) for regional aircraft.

A significant contribution to achieve a reduction of environmental impact is considered to be provided by a new MTM. For this reason this domain, working in a tight cooperation with SGO ITD, will work with the aim of defining a more efficient way to manage trajectories in order to reduce noise, emissions and fuel consumption for a typical regional aircraft. Trajectory optimization will be performed both on a single flight phase (e.g. climb, approach, cruise) and on a whole mission profile.

After having defined optimized trajectories, new green technologies integrating these concepts will be developed and integrated in a regional aircraft flight simulator. A demonstration will be performed in order to verify results achievable with these new green technologies. Simulation results will be analysed and a final assessment will provided to European Commision through Technology Evaluator.

It is clear the importance for having a GRA Simulator as much as possible representative of the real A/C.

GRA WP4 WBS:

1. GRA 4.1 - High level requirements for MTM
   - WP 4.1.1 - A/C high level requirements
   - WP 4.1.2 - Requirements for MTM demo
2. GRA 4.2 - MTM architectures
   - WP 4.2.1 - Avionics Architecture
   - WP 4.2.2 - Basic Prototyping Tool
3. GRA 4.3 - Prototyping tool for MTM functions
4. GRA 4.4 - Definition of flight simulator demo
5. GRA 4.5 - Demo preparation & test for MTM
   - WP 4.5.1 - Preparation of flight simulator demo for MTM
   - WP 4.5.2 - Flight simulator demo for MTM
6. GRA 4.6 - Analysis and final reporting

The results of the activity object of this CfP will be integrated in the GRA simulator for allowing a reliable evaluation of environmental impact reduction due to the integration of green technologies (e.g. green FMS).

1.1.2 Interfaces to ITD:

N/A

1.2 Reference documents

N/A

1.3 Scope of work :

This Call for Proposal is linked to GRA Area 4 activities. The aim of this WPs is to update a flight simulator on which the MTM green functions will be integrated and fully tested. In order to enable a deep analysis the flight data will be recorded.

Rationale:

The development and implementation of the future MTM functions in GRA ITD, will also rely upon the availability of high accuracy aircraft positioning systems (e.g. GPS, GLONASS, GALILEO) and upon a certain number of related advanced functions (e.g. RAIM, PRAIM).

From this point of view, the availability of an high fidelity and accuracy GPS system simulation, integrated in GRA flight simulator is an essential factor for integrating green technologies (e.g. FMS) in GRA simulator and evaluating the reduction of environmental impact coming from the adoption of those green solutions.

Activity:

The selected candidate shall develop two simulation tools:

- the first one simulating, in real time, a complete constellation of GPS satellites in terms of movement in space, ephemeris, control capabilities, signals emitted towards earth, failures and malfunctions etc…;
- the second one simulating, in real time, the basic and advanced functions of a generic and moving ground or airborne receiver interfaced with the GPS constellation simulator and including the most common failures and malfunctions.

Main requirements are the following:

- The interface between the GPS constellation and the GPS receiver simulator shall not necessarily reproduce the real signal emitted by the satellites; however the basic and advanced functions of the most common receiver built for aeronautical use shall be available
- The two simulation softwares shall be capable of running on different computers and being interfaced through the use of TCP/IP or UDP protocol
- The GPS constellation simulation shall be capable of being interfaced with several GPS receivers simulations, running on different machines, at the same time.
- The GPS receiver simulation shall be capable of being interfaced, through an ad-hoc interface, with the most common on board avionic systems of nowadays aircraft.
- The developed SW shall allow the users the possibility to implement new features that could be required during the GRA project lifecycle without the necessity to involve the developers.
- The SW shall be developed using C/C++ language and shall be able to run on LINUX Operating System

A complete set of high level requirements, included in a System Specification (SS), will be provided to the selected candidate at the Technical Kick Off Meeting.

Such a development will consist of a five steps approach including the following main activities:

- Definition of the detailed requirements, interfaces and functions performed by the GPS constellation simulation
- Definition of the detailed requirements, interfaces and functions performed by the GPS receiver simulation
- Definition of the validation tools and trials
- Software development
- Software testing and validation

1.4 Type of work :

The type of work consists in Design, Development and Testing.

1.5 Requirements

N/A

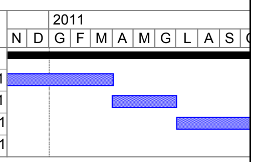
1.6 Other

N/A

1.7 Schedule, milestones and deliverables:

The schedule foreseen for this CfP is reported in the following diagram:

ID		Nome attività	Inizio	Fine
1		**Development of an advanced GPS system simulation**	**lun 01/11/10**	**ven 30/12/11**
2		Definition of the GPS constellation and GPS receiver simulator requirements	lun 01/11/10	gio 31/03/11
3		Definition of the validation tools and trials	gio 31/03/11	gio 30/06/11
4		Development of the simulation software	gio 30/06/11	ven 28/10/11
5		Software validation trials report	ven 28/10/11	ven 30/12/11



(**Note**: in the fig. T0 is assumed to be 01/11/10)

2. Special skills, certification or equipment expected from the applicant

The selected candidate shall have the following expertise:

- Participation to previous researches;
- Knowledge and experience in global positioning systems (real and simulated);
- Knowledge and experience in the simulation of avionic systems;
- Knoweledge and experience in the real time, man in the loop aircraft simulation in Linux-Unix environments.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Definition detailed requirements/interfaces/functions of the GPS constellation and GPS receiver simulator	Document providing the description of the simulators requisites and functionalities	T0 + 4
D2	Definition of the validation tools and trials	Document detailing the validation tools and trials that will be performed to demonstrate the correspondence between the developed software and the requisites defined in D1	T0 + 6
D3	Development of the simulation software	Delivery of the software and related user manual	T0 + 12
D4	Software validation trials report	Report on tool validation trials	T0 + 14

4. Topic value (K€)

The total value of this work package shall not exceed:

330, 000 €

[three hundred thirty thousand Euro]

Please note that VAT is not applicable in the frame of the CleanSky programme.

5. Remarks

N/A

Clean Sky - Green Rotorcraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-GRC	**Clean Sky - Green Rotorcraft**	**1**	**430.000**	**322.500**
JTI-CS-GRC-01	*Area-01 - Innovative Rotor Blades*			
JTI-CS-GRC-02	*Area-02 - Reduced Drag of rotorcraft*			
JTI-CS-GRC-03	*Area-03 - Integration of innovative electrical systems*		**430.000**	
JTI-CS-2010-3-GRC-03-003	Piezo power supply module		430.000	
JTI-CS-GRC-04	*Area-04 - Installation of diesel engines on light helicopters*			
JTI-CS-GRC-05	*Area-05 - Environmentally friendly flight paths*			

Clean Sky Joint Undertaking
JTI-CS-2010-3-GRC-03-004

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-GRC-03-004	*Piezo Power Supply Module*	End date	To + 52 months
		Start date	T0

1. Topic Description

Acronyms
GRC3: Work Package 3 of the ITD GRC
EDS: Eco Design System bench
PPS: Piezo Power Supply Module
PAB: Piezo Actuator Bench
HPAS: Helicopter Piezo Actuation System
MMI: Man Machine Interface
PDR: Preliminary Design Review
CDR: Critical Design Review
FAI: Final Article Inspection
QR: Qualification Review
ICD: Interface configuration document
FMECA: Failure Mode, Effects, and Criticality Analysis

1. Background:

The Green Rotorcraft research consortium of Clean Sky is aiming to develop innovative electrical systems and technologies improving overall rotorcraft efficiency and reducing carbon (and other undesirable) emissions in the frame of GRC3 program.

This potentially requires:

- The development of electrical system components that are more efficient in power usage (and thus will reduce the fuel burn required for their operation).
- The development of electrical systems that reduce the mass of rotorcraft, providing an overall efficiency improvement.
- The development of electrical system technologies that support other vehicle changes that improve rotorcraft efficiency.

The strategy to be followed will be to specify, manufacture, integrate and rig test the technologies needed to achieve the objectives. To do so, an Eco Design System bench (EDS) will be jointly developed in the frame of the GRC3 to implement 270VDC onboard electrical network. Different load benches will then be connected to the EDS bench in order to test different technologies and system applications.

The work package GRC3.7 “energy for piezo-actuators” focuses on power electronics systems that will support the implementation of piezoelectric actuators, the leading actuation technology option for future active rotor systems. The main objectives are:

- Definition of requirements for energy supply to piezo actuators in embedded system
- Demonstration and test of an energy supply system on the EDS Common Test Bench

This workpackage aims to develope a Piezo Power Supply module (PPS) and a Piezo Actuator Bench (PAB) in order to demonstrate a complete piezo actuation system on EDS bench and give consolidated recommendations in a final report.

2.Scope of work:

To achieve this goal, the consortium wishes to enter into a partnership with a company or consortium able to develop the Piezo Power Supply module and the associated Man Machine Interface for controls.

Providing and controlling the electrical power to piezo-actuators pose specific implementation problems. Indeed, to provide sufficient strain or displacement in dynamic applications, state of the art piezo actuators requires an operation voltage up to 1000V and high charge and discharge currents. They have primarily non linear capacitive impedance changing significantly with the driving voltage amplitude, temperature, and load conditions. The power electronics shall be able to manage peak power transients and reactive power. It shall also consider specific constraints for integration on aircraft: limited weight and dimensions, qualification for functioning in hard environmental and EMI conditions.

Moreover, the power requirements linked to piezo actuation are highly dependent on the actuators and the applications considered. A progressive approach with a preliminary study is necessary to define the characteristics for an optimum HPAS system. In a first step, the partner shall perform a preliminary theatrical study where different hypothesis shall be considered for the following parameters:

- output voltage range (-200 to 1000V, -160 to 800V, -120 to 600V, -100 to 400V, -50 to 200V)
- equivalent capacity range per channel (400 to 1000µF, 100 to 400µF, 50 to 100µF, 25 to 50µF, 10 to 25µF)
- ratio of active power on reactive power (between 5 and 25%)
- output current ripples limit (3%, 5%, or 10% of maximum total current)
- bandwidth (500Hz at -3dB)
- typical actuation frequency spectrum will be provided.

This study will enable to determine the semiconductor technology, design concept (i.e. capacitive or inductive energy storage) and architecture for the power electronics presenting the best performances for each case. The corresponding power losses, design constraints, dimensions and weight, and the output frequency limits, will be evaluated. Impact of output current ripples limitations on weight and dimensions shall be analyzed.

In a second step, a design, which covers most piezo actuator applications with acceptable performance, will then be selected for implementation into the HPAS system prototype. A MMI module shall also be defined to control the PPS module during the validation tests. The PPS and MMI modules shall be manufactured and validated by the applicant.

In a third step called “system validation tests”, they will be tested and validated together with the PAB bench before integration and the final tests on the EDS Common Test Bench.

In conclusion, the applicant will perform the following tasks in cooperation with partners from the Green Rotorcraft research consortium:

- Review and analyze the technical specifications defined by the partners concerning the whole system, the MMI and PPS modules.
- Perform a case by case preliminary study (as described above) to determine the semiconductor technology, design concept, and architecture for the power electronics presenting the best performances for different ranges of output voltage, equivalent capacity, and actuation bandwidth.
- Identify key issues that should be addressed through bench prototype tests or through technology and design analysis studies
- Develop and manufacture the PPS and MMI modules.
- Validate the PPS and MMI module with 270VDC power supply and PAB bench during the System validation tests

- Characterize the Piezo Power Supply module and give consolidated recommendation for its design and manufacturing
- Develop simulation model of PPS module under SABER or compatible tool
- Support for the definition of interfaces of the bench system
- Support for the test procedure definition on the EDS bench
- Support during the tests to be performed on the EDS bench

The GRC partners expect to participate in the tasks both in a supportive role and to understand the evolving design approach and performance parameters of the system all along the project.

The main requirements for the Piezo Power Supply module are:

- Two output channels
- Providing output apparent power from 0.5 to 8 kVA per channel (to be defined after the preliminary study)
- Exploiting full capability of the 270VDC onboard network provided by the EDS bench
- Providing high output voltage and instantaneous power with large bandwidth and precise regulation to be capable of most piezo actuation types
- Configurability and controllability to be adaptable to different piezo actuations
- Use of technology and techniques to optimize efficiency, volume, and weight
- Identifying critical supply failure effects/modes (piezo actuators or internal failure), provide suitable detection capabilities and determine optimal management

The Man Machine Interface shall consist of:

- Operator control panel with switches and indication lights (main HPAS system commands and status)
- Interface software on a computer platform

The main requirements for the Man Machine Interface module are:

- Process the operator’s manual requests and send the corresponding commands to the PPS.
- Display HPAS system information to the operator.

The MMI Module shall be designed as laboratory equipment.

The applicant shall deliver two sets of PPS & MMI modules as well as associated cabling.

3. Special skills, certification or equipment expected from the applicant

The applicant shall have experience in piezoelectric actuators, in power electronics, and possibly in aeronautics applications (please provide details).

The applicant shall be able to cover the complete process chain for the manufacturing of power electronics relevant to supply energy for piezo actuators and functioning with 270VDC onboard network. This includes the specification analysis, technology choice for the different components, design, manufacturing, and validation of a prototype bench in the relevant configuration (first tests with piezo dummy before the PAB bench will be provided).

The applicant should have the industrial capacity to exploit the demonstration results – i.e. to further develop, optimise, and produce the power electronics under commercial conditions and to support the customers on a sustainable basis.

4. Major deliverables and schedule

Deliverable	Title	Short Description (if applicable)	Due date (month)
D01	*Requirements analysis*	*Review of the requirements defined in System Specification, PPS module specification & SoW, PAB module specification*	*T0 + 1month*
D02	*Preliminary Study*	*Case by case preliminary study to determine the semiconductor technology, design concept and architecture for the power electronics presenting the best performances.*	*T0 + 5months*
D03	*PPS design file*	*Detailed design description, ICD, validation and qualification procedures, simplified FMECA*	*PDR: T0 +7months* *CDR: T0 +11months* *FAI : T0 +17months* *QR: T0 +22months*
D04	*MMI description*	*General description of the MMI and user manual*	*T0 +11months*
D04	*PPS and MMI units (x2)*	*Delivery for validation tests.*	*T0 +24months*
D05	*Validation tests procedure & report*	*Validation test procedure and report.*	*T0 +32months*
D06	*Final report*	*Consolidated recommendations for PPS module design based on test results and complementary studies.*	*T0 +49months*

Topic value (€)

The total anticipated eligible cost of the proposal including manpower, travel costs, consumables, equipment, other direct costs, indirect costs, and subcontracting shall not exceed:

€ 430 000.00 (VAT not applicable)

[Four Hundred Thirty Thousand Euro]

5. Remarks

- All core RTD activities have to be performed by the organisation(s) submitting the proposal. If some subcontracting is included in the proposal, it can only concern external support services for assistance with minor tasks that do not represent per se *project* tasks. The proposal must :

- indicate the tasks to be subcontracted ;
- duly justify the recourse to each subcontract ;
- provide an estimation of the costs for each subcontract.

(concerning subcontracting, see provisions of the Grant Agreement Annex II.7)

- The Piezo Actuator Bench (PAB) is out of scope of this Call for Proposal.
- The Partner shall have at its disposal a 270VDC power supply for bench tests.

- The expected length of the technical proposal is 50 pages.

Clean Sky - Sustainable and Green Engines

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	**4**	**12.500.000**	**9.375.000**
JTI-CS-SAGE-01	*Area-01 - Geared Open Rotor*			
JTI-CS-SAGE-02	*Area-02 - Direct Drive Open Rotor*			
JTI-CS-SAGE-03	*Area-03 - Large 3-shaft turbofan*		**10.000.000**	
JTI-CS-2010-3-SAGE-03-002	Aeroengine intake technology development		10.000.000	
JTI-CS-SAGE-04	*Area-04 - Geared Turbofan*			
JTI-CS-SAGE-05	*Area-05 - Turboshaft*		**2.500.000**	
JTI-CS-2010-3-SAGE-05-010	Development of a Wasted Heat Regeneration System (WHRS)		1.200.000	
JTI-CS-2010-3-SAGE-05-011	Development of exhaust noise attenuation technologies		1.100.000	
JTI-CS-2010-3-SAGE-05-012	Development of an advanced system for pollutant measurement		200.000	

Topic Description

CfP topic number	Title		
JTI-CS-2010-2-SAGE-03-002	**Large 3-shaft Demonstrator – Aeroengine intake technology development**	**Start date**	*Jan. 2011*
		End date	*Aug. 2014*

1. Topic Description

SAGE3 project aims at development and demonstration of a large 3-shaft bypass engine Demonstrator. A large role in the efficiency of the overall engine is played by the fan and bypass system. The technological challenge is to increase the bypass ratio to move as large a massflow of air as efficiently as possible while reducing the weight of the fan and associated structures.

The aero-engine intake has to comply with a variety of functional requirements. The novel intake to be developed in SAGE shall show a high level of integration with an all composite fan system, which will be used to achieve the following main objectives:

- Advanced aero-acoustic design definition for inner Intake aero lines and state of the art acoustic panel definition: Cruise conditions as well as off-design conditions such as cross-wind will be taken into account.

- develop improved structural integrity design of the Intake assembly: Structural integrity has to be achieved at minimum weight. An ice protection system should be designed.

- develop advanced inner barrel acoustic treatment for enhanced fan stability and compatibility. The intake has to accommodate sufficient acoustic liner area to reduce fan forward noise.

- demonstrate novel manufacturing techniques for acoustic panel fabrication and life cycle cost reduction

- develop a low cost model and supply chain assessment for new method of construction, assembly and manufacturing for Intakes assembly

In this context, RTD activities are foreseen, on the intake, with the objective to demonstrate technologies via running on the demonstrator engine and a fan blade off rig test in order to mature the intake in view of a potential large 3-shaft engine application.

The activity needs to comply with the requirements developed within the concept design phase presently ongoing at SAGE 3 level.

The partner shall in particular perform the following tasks:

Task 1: Design and analysis of novel intake including acoustic liner

Schematic and main dimensions of the intake are shown in Fig 1. The intake is expected to be fully 3-D with the throat and highlight non-circular.

Design and analysis of a complete flight intake, including acoustic lining, ice protection system and external cowling using trade studies to produce an optimised design.

In addition, costed scenarios for serial manufacturing and in service maintenance shall be developed.

The acoustic liner will be optimised both for noise attenuation and to enhance fan stability and may include varying depths or other novel design features. The details of the liner requirements will be developed by ITD Topic leader in 2010 and the details will be agreed with the intake partner during the concept design phase.

Any material testing or manufacturing trials required to validate the design choices shall be carried out and reported.

Task 2: Intake and acoustic liner manufacturing and assembly

Two test articles are required:

- An intake to be used for engine ground testing in an indoor test bed. This intake must have a lipskin and an acoustic barrel. As this is a ground test article only, the lipskin shape may be different from the study design flight intake in order to improve ground running performance (this will be agreed prior to the detail design phase). The intake should be suitable for up to 500 hours engine testing.
- A barrel section only for use on a fan blade off full-scale rig test (this barrel will be identical in design to the one used on the ground test intake).

Other intake systems, such as ice protection and/or structures such as a novel external cowl may be included in the ground test article if the intake partner wishes to demonstrate such technology on an engine test.

Documentation justifying that the articles are fit for purpose for their testing is required.

Additionally, the partner may be asked for samples of acoustic liners.

Task 3: Intake validation support

The structural and functional properties of the intake will be validated during the full scale engine test and the full scale rig fan blade off test. The partner shall support the test during the preparation phase, on site and during the appraisal phase.

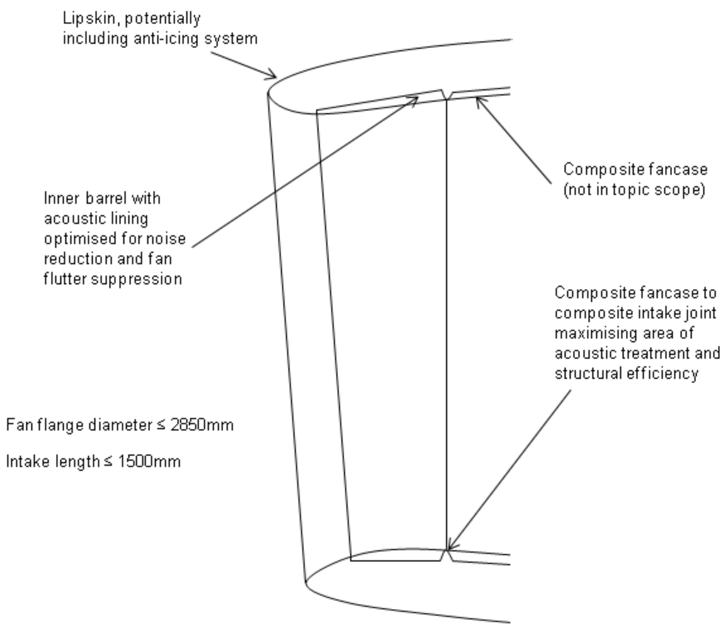


Figure 1: Schematic section and main dimensions of a typical intake

2. Special skills, certification or equipment expected from the applicant

Extensive experience in the detail design, development and manufacture of light weight metal and/or composite parts for high performance aerospace applications in general, and specifically in the area of aero-engine intakes. Capability of integrating acoustic liners is required. Experience of suitable quality control systems is essential.

Successful experience, with demonstrable benefits, of application of innovative manufacturing and material technologies to reduce weight and cost of aerospace parts is an asset. Availability of technologies at high readiness level to minimise programme risks is an asset.

Experience in aerospace R&T and R&D programs.

The partner needs to demonstrate access to the manufacturing facilities required to meet the goals. Of particular interest is the ability to manufacture hardware of the size required.

The activity will be managed with a Phase & Gate approach and management plan has to be provided. The partner will be expected to conduct risk management and share visibility of the risks. ITD Topic leader will approve gates and authorize progress to subsequent phases.

Technical/programme documentation, including planning, drawings, manufacturing and inspection reports, must be made available to ITD Topic leader.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.1	Intake launch review	Participate in launch review for SAGE3 intake	Jan 2011
D1.2	Intake concept review	Design concept proposals and trade studies. Concept will be chosen at this time.	June 2011
D1.3	Intake preliminary design review	Design study intake PDR and also test hardware PDR.	October 2011
D1.4	Completed production intake design study	Costed scenarios for production & in-service support	June 2012
D2.1	Test intake critical design review	CDR for ground test intake and fan blade off test barrel	March 2012
D2.2	First Article Inspection	Review of manufactured hardware at partner's manufacturing facility	Dec 2012
D2.3	Delivery of ground test intake and intake barrel for FBO test	Test hardware and associated conformance documents.	Dec 2012
D3.1	Support for validation testing	On site or remote support as required	Q1 & Q2 2013
D3.2	Test analysis complete	Report analysing validation data	Q1 2014

4. Topic value (€)

The total value of biddings for this work package shall not exceed

€ 10,000,000/00
[ten millions euro]

Please note that VAT is not applicable in the frame of the CleanSky program

5. Remarks

Partners are encouraged to propose additional turbofan intake related technologies for validation on the ground engine test.

The dates of the deliverables listed above, other than the FPS dates for test hardware, are preliminary and alternative dates will be considered.

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-SAGE-05-010	Development of a Wasted Heat Regeneration System (WHRS)	Start date	*10/2010*
		End date	*04/2012*

1. Topic Description

The SAGE5 project aims at developing a new helicopter engine presenting significant improvements in term of noise and gaseous emissions. In this framework, the fuel consumption reduction is a key objective.

This objective can be achieved by increasing the pressure ratio of the compressor (this is one the objectives of SAGE5 demonstration). Nevertheless, technological issues on small turbo-shafts are very constraining and significant improvement of pressure ratio is a challenge.
One complementary solution consists in recovering the heat lost in the exhaust by a heat recovery system by converting the wasted energy from the exhaust into mechanical power. The system is dubbed **Wasted Heat Regeneration System (WHRS).**

Concept studies have been performed on parallel of Clean Sky program. They led to the following results which are the technical requirements of the call for proposal.

Description of the WHRS

The system is composed by a heat exchanger and a hot air piston engine.
- The heat exchanger aims at gathering a part of the energy dissipated at the exhaust of the turbine. It allows heating the air of the so called “hot loop” of the WHRS.
- This “hot loop” is thermally connected to the piston engine which converts the thermal energy in mechanical energy available on a shaft for various purposes: electric generation, mechanical drive…

The heat exchanger
The exchanger is a air / air type and is directly installed in the gas turbine exhaust nozzle. On one side, it will be heated by the hot gases passing through the exhaust. On the other side, it will heat up the pressurised air flow coming from and going to the piston engine (hot loop).

The challenge of the study is related to the high thermomechanical loads applied to the exchanger: (Peak temperature of 700°C, pulsed pressure at 12-15 bars, vibrations …) associated with aeronautical constraints: low mass, high efficiency, small dimensions, reliability, safety …

The exchanger will be integrated in a 250mm diameter turbine exhaust nozzle with a minimum impact on exhaust gas flow (to minimise pressure losses). The recuperated thermal power will be around 150kW.

The challenge of manufacturing is induced by the numerous welded junctions on thin components that should guaranty the perfect tightening of the system under harsh conditions (temperature, pressure, vibration).

2 heat exchangers will be necessary for the demonstration. One for first verification purpose and the other for endurance testing.

The hot air piston engine

This is an alternating piston engine rotating at 12000 rpm. Its characteristics are as follows:

- 3 or 4 cylinders (to be defined)
- A total capacity between 2 and 3 litres
- No internal combustion, no use of fuel
- 1 cycle per round
- 2 loops:
    - An open loop called “cold loop” that realise the inlet and the exhaust and that use usual technologies for the admission/exhaust.
    - A closed loop called “hot loop”, connected to the heat exchanger with a novel system without valves and working under the same temperatures than the exchanger. This system will be composed by mobile parts subjected to high mechanical and thermal loads. It implies the use of materials with high structural strength at high temperature and with a low coefficient of thermal expansion (CTE). The surfaces finishing and the accuracy of the manufacturing will be the key parameters to guaranty the tightening.
- An engine block. Some of the engine block casings will be in aluminium with adapted local treatments
- The pistons are based on usual technologies
- The rods will use light materials
- The lubrication system will be based on usual technologies

The **accuracy of manufacturing** will be very important for:
- the friction areas of the moving parts
- for the parts involved in the dynamical tightening.

The **material quality** (defects, porosity, inclusions, …) level is a key parameter to avoid a failure under high speed operation

Work to be performed by the partner(s)

- Detailed study and manufacturing of 2 heat exchangers
- Detailed study (based on an provided preliminary study) and manufacturing of a component test bench for the admission system of the hot loop. Test of the admission system for risk mitigation purpose.
- Manufacturing of the hot air piston engine based on the detailed study provided by ITD Topic leader
- Study and manufacturing of a test bench for the piston engine alone and with the heat exchanger. The objective of the rig is to debug the WHRS and to perform endurance test (the hot source will be an electrical resistance or other device replacing the turbine exhaust). This test bench should be an adaptation of an existing engine test rig.
- First verification of the piston engine and endurance test (approximately 500h running) on the whole system (WHRS)

2. Special skills, certification or equipment expected from the applicant

This project can require several partners, exhibiting high and proven experience in designing, manufacturing and studying heat exchangers.
Concerning the piston engine, the partners should demonstrate their capacity to prototype and manufacture alternating piston engine system and innovative distribution systems. The partners should also demonstrate their capability to perform high accuracy manufacturing, with high quality surfaces, high material quality, and using high performance materials (strength, temperature, low CTE).
Concerning the test benches, the partners must exhibit their skills in designing and manufacturing test rigs, including the command systems and safety aspects. The consortium should also prove its capability to conduct piston engine tests and component tests.
For the WHRS test rig (whole system), the consortium should provide an existing test rig and should adapt it for the purpose of the demonstration.
The activity will be managed with a Phase & Gate approach and management plan has to be provided. ITD Topic leader will approve gates and authorize progress to subsequent phases.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	2 exemplars of the air piston engine (based on a provided detailed design)	1 prototype will be used for debugging and performance measurement 1 prototype will be used for endurance testing in parallel	T0+8
D2	Technical outcomes of concurrent engineering of the heat exchanger	A preliminary study and a first proposal of detailed design will be provided by ITD Topic leader	T0+2
D3	2 exemplars of the heat exchanger	1 prototype will be used for debugging and performance measurement 1 prototype will be used for endurance testing in parallel	T0+5 T0+8
D4	Technical outcomes of component test rig concurrent engineering and manufacturing	This test rig will be used for risk mitigation purpose on the hot loop distribution system. A preliminary study and a first draft of detailed design will be provided by ITD Topic leader.	T0+4
D5	Hot loop distribution system risk mitigation test results.	1 month test series	T0+5
D6	Piston engine alone and whole WHRS test bench: detailed study of an existing rig adaptation and associated manufacturing activity.	The hot source is NOT a gas turbine	T0+8
D7	WHRS debugging and endurance test results	First phase of test based on the piston engine alone debugging Second phase of test on the whole WHRS debugging and endurance	T0+11 T0+14
D8	Synthesis report		T0+18

4. Topic value (€)

The total value of biddings for this work package shall not exceed

€ 1,200,000/00
[one million two hundred thousands euro]

Please note that VAT is not applicable in the frame of the CleanSky program

5. Remarks

For cost saving purpose, complementary test series will be performed by ITD Topic leader on the WHRS integrated with a gas turbine. It requires specific test rig (turboshaft test rig) available at ITD Topic leader.

The component developed in this call for proposal will be first verified and optimised in Clean Sky and will be then used by ITD Topic leader for the demonstration of the WHRS integrated into one turbo-shaft.

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-SAGE-05-011	Development of exhaust noise attenuation technologies	**Start date**	*12/2010*
		End date	*12/2012*

1. Topic Description

The SAGE5 project aims at developing a new helicopter engine that meets the ACARE targets in term of noise and greenhouse gas emissions reduction. Concerning noise issues, it is of uttermost importance to reduce emitted noise at the closest to the noise source. Acoustic liners that prove to be efficient in flight need an important depth that cannot be integrated everywhere in the engine.

Past experiences gained during former EU-funded research projects on hot stream liners design show that promising attenuation could be achieved but integration issues of such liner very close to the source remains a challenge.

Two innovative noise reduction concepts are envisaged:
- Quiet plug
- Quiet Exhaust diffuser,

hopefully installed on the same piece of hardware

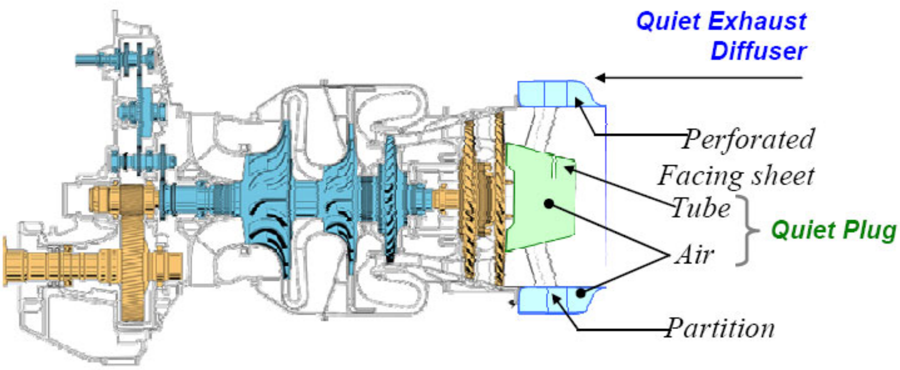


Figure 1. Engine with a quiet plug and a quiet exhaust diffuser (combined)

Mass and cost increase restrains the use of acoustic technologies on the current gas turbines. Therefore, the materials to be used for the manufacturing of the parts are:

- **Ferritic Stainless steel** as a low cost material. This material is currently not used in aeronautics. The project will determine if this transfer of technology from the automotive industry is feasible.
- **TiAl alloy** as a light alternative for only one exemplar of Quiet Exhaust diffuser. TiAl is a light material with outstanding thermal resistance capability. However, it is difficult to form and fragile and the welding of TiAl sheets is not trivial. Therefore, previous envisaged aeronautical applications have failed. Due to the low stress level of the Quiet Plug and Exhaust Diffuser, this application is ideal to demonstrate all the mass gain associated with TiAl alloys.
- As the manufacturing activity is challenging due to the use of non proven materials, a **Nickel Based solution** could be envisaged as a back-up if the Ferritic and/or TiAl manufacturing process fails.

Academic study

Some partitions are required inside the liner (considered as a hollow cavity above a perforate plate) in order to maximise the acoustic attenuation. However, these partitions add costs and weight. The project shall provide experimental evidence of the trade-off between the number of partitions and the acoustic absorption, in order to deduce trade-offs between cost, mass and noise benefits.

In order to understand the link between the number (and orientation) of partitions and the acoustic efficiency, an experiment using a test bench with controlled flow/acoustic condition is expected, under cold conditions. This test bench must be provided by the selected partner.

This experiment will allow measuring the noise attenuation variation when the number of partitions is under the required number imposed by plane wave propagation inside the cavity.

The main influence of the following parameters on the noise attenuation variation is expected:

- The orientation of the partitions: azimuthal and axial
- The main flow Mach number (Mach < 0.3)
- The use of facing sheets optimised for
  - locally reacting case
  - non locally reacting case

Instrumentation will be localised before and after the lined section, and should allow the discrimination of propagating waves in both directions in the duct, in order to provide a complete sound energy assessment.

Sufficient Sound Power must be provided through adequate sound sources, so that generated broadband noise signal remains visible after attenuation by the liner.

12 test configurations are expected.

The output of this study, that is the optimal number of partitions, will be used as a design criterion for manufacturing the full-scale test hardware.
A numerical study used to correlate the experimental data will be done beside the project by Turbomeca

The figure below describes the hardware with the integrated noise reduction technologies.

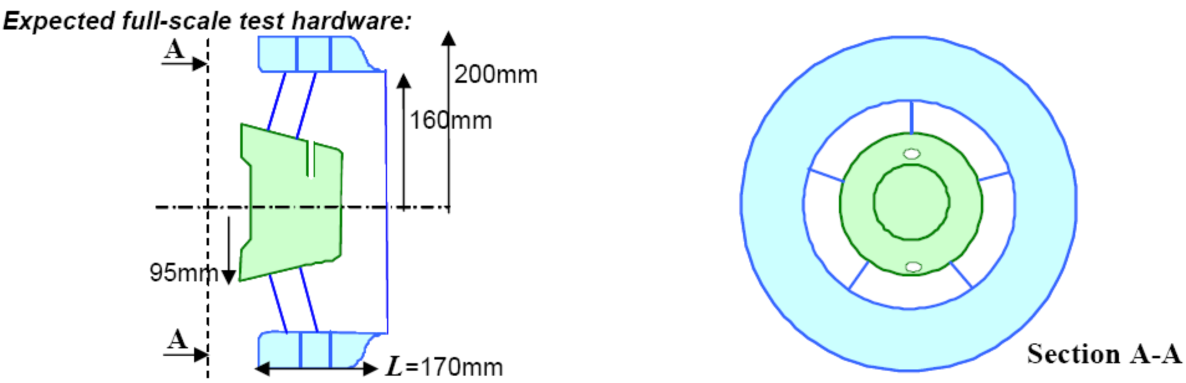


Figure 2. Required hardware to manufacture

Three items are expected from the project:

- 1 One item manufactured with Ferritic alloy material (named : Short Quiet Exhaust) including:
  - A quiet plug tuned at one frequency.
  - An optimal acoustic liner on the exhaust diffuser (with the optimal number of partitions) side with reduced treatment length (L).
- 2 One item manufactured with Ferritic alloy material (named : Quiet Exhaust) including :
  - A quiet plug tuned at one frequency.
  - An acoustic liner on the exhaust diffuser with the optimal number of partitions issued from the

academic test campaign.
- 3 One item manufactured in TiAl (named : Long Quiet Exhaust)
  - A quiet plug tuned at two different frequencies.
  - An optimal acoustic liner on the exhaust diffuser side with additional length L compared to item 1.

The manufacturing of three items with different length will allow to establish a trade-off between cost and weight issues.

The noise reduction impact that will complete this trade-off will be established in Clean Sky using full scale acoustic engine tests provided by Turbomeca.

Such result is of outmost importance for such industrial application as the cost/weight issues have been identified as a show stopper with unfortunately few knowledge on the trade of between these parameters.

The consortium of partners will have to achieve the following task:

-1 Manufacturing the lab test bench, realisation of the academic test campaign and manufacturing of the test samples in order to determine the noise reduction variation with the number of azimuthal and axial partitions => recommendation about partitions distance and orientation

-2 Characterisation of the manufacturing capability of the new materials (Ferritic Alloys and TiAl) and improvement of the state art if necessary.

-3 Design three hardware items based on the acoustic specification provided by Turbomeca. The acoustic specifications will be the cavity depth of the acoustic treatment (Quiet Exhaust diffuser), perforation rate and size of the perforation for the facing sheet.
The aerolines of the parts will also be provided by Turbomeca.
The number of partitions will come from the academic study.

The following theoretical studies on the three hardware are expected:
- Mechanical & Thermal
- Vibration
- Technological design (accordance with the interfaces)

- 4 Manufacture the three items
- 2 Items shall be manufactured in Ferritic Alloy
- 1 Item will be manufactured in TiAl. Depending of the maturity of the manufacturing process, a back-up solution in nickel based alloy or in Ferritic material will be manufactured aside.

The hardware will be tested on a turboshaft engine by Turbomeca in the framework of Clean Sky program.

2. Special skills, certification or equipment expected from the applicant

The applicant shall exhibiting high and proven experience in designing, manufacturing and studying TiAl and Ferritic alloys or related technologies.
A test facility with flow is required with a flow path around 250mm diameter and flow Mach number M<0.3. The partner involved in the academic test should prove experience in the determination of the liner impedance (determined for each acoustic mode).
In case of response by a several partners, at least one of the partners (the coordinator) must exhibit experience in the management of a consortium.
The activity will be managed with a Phase & Gate approach and management plan has to be provided. Turbomeca will approve gates and authorize progress to subsequent phases.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Samples dedicated to the academic test	Hardware	T0+9
D2	Materials Characterisation (Ferritic and TiAl alloy)	This report will include results from additional material tests required (mainly high cycle fatigue and thermo-mechanical behaviour at high temperature with metallographic analysis taking into account thickness influence) prior the launch of the manufacturing phase.	T0+9
D3	Material for the Preliminary Design Review	The goal of the PDR is to check the ability to manufacture the hardware with Ferritic and TiAl alloys. If a NoGo is given for one of the materials, a back-up material (Nickel Based alloy) will be used to launch the detailed design study.	T0+9
D4	Partition Test Report and test analysis	Report detailing the test realised, the global attenuation (and the modal transfer matrix) for each configuration (partition & Mach number) and a recommendation on the optimal number of partition.	T0+15
D5	Design Report	Report including drawings ,the technological study and justifying vibration and mechanical compliance to the specifications	T0+17
D6	Material for the Critical Design Review	The goal of the CDR is to launch the manufacturing phase and check that all inputs from the design phase are compliant with the specifications	T0+17
D7	Report on the manufacture of the 3 hardware	Hardware + Manufacturing process description	T0+24

4. Topic value (€)

The total value of biddings for this work package shall not exceed

€ 1,100,000/00
[one million one hundred thousands euro]

Please note that VAT is not applicable in the frame of the CleanSky program

5. Remarks

Preliminary and Critical Design Review shall be included by the applicant in the process of this project in order to reduce the project risks.

As a general guide, it is foreseen that the length of proposals for this topic will be approximately **30 pages** (depending on the applicant's need to adequately explain the proposal).
In this context, please note also the instructions on minimum font and margin sizes and other matters in the document *"Rules for Participation and Rules for Submission of Proposals and the related Evaluation, Selection and Award procedures".*

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-SAGE-05-010	Development of an advanced system for pollutant measurement	Start date	*01/2011*
		End date	*01/2012*

1. Topic Description

The SAGE5 project aims at developing a new helicopter engine presenting significant improvements in term of noise and gaseous emissions.

In this framework, the development of a new adaptable and reliable combustor test module, involving the measurement system, will allow significant improvement in the characterisation of flow characteristics of exhaust hot burnt gases in case of a small reverse flow annular combustor. The characteristics to be measured are: temperature, pollutants (chemical species concentration) and velocity maps.

The objective is clearly devoted to small engines whose compactness leads to a reverse flow annular shape for combustor, both behaviours making harder space and time resolved measurements at the combustor exit.

Such measurements are required to qualify the combustor in terms of combustion efficiency, as well as homogeneity of radial and azimuthal temperature profiles. The former impacts on fuel consumption and pollutants emissions while the latter impacts on the turbine efficiency and life time.

Thus, despite difficulties to obtain in so severe environmental conditions ($T \approx 1600$ K), fine measurements at combustor exit are critical for design improvement. Moreover, such information facilitates the validation of numerical codes or models allowing a gain on every aspect of combustor design and performances, and at least, a significant reduction of the engine development cycle. This can be achieved, not only by reliable mean values but also by high frequency measurements allowing for data processing (statistic, FFT…).

Usually, the displacement system is placed downstream of the combustor. The rakes of thermocouples and gas sampling probes are assembled on the shaft which is surrounded by the hot gas flow. Thus, it is subjected to high levels of thermal stress which led to complicated technical solutions to ensure both integrity and functionality of the device, as well as reliability and accuracy of the measurements.

In order to bypass these constraints, ITD Topic leader performed a preliminary study focused on the concept that is shown on **figure 1**: a rotating shaft placed inside the module and a measurement system placed upstream of the combustor.

This study concludes that such geometry would solve thermal problems previously pointed out, but raises to several problems (compactness, cooling, set in motion, maintenance…) which need further investigations to be solved.

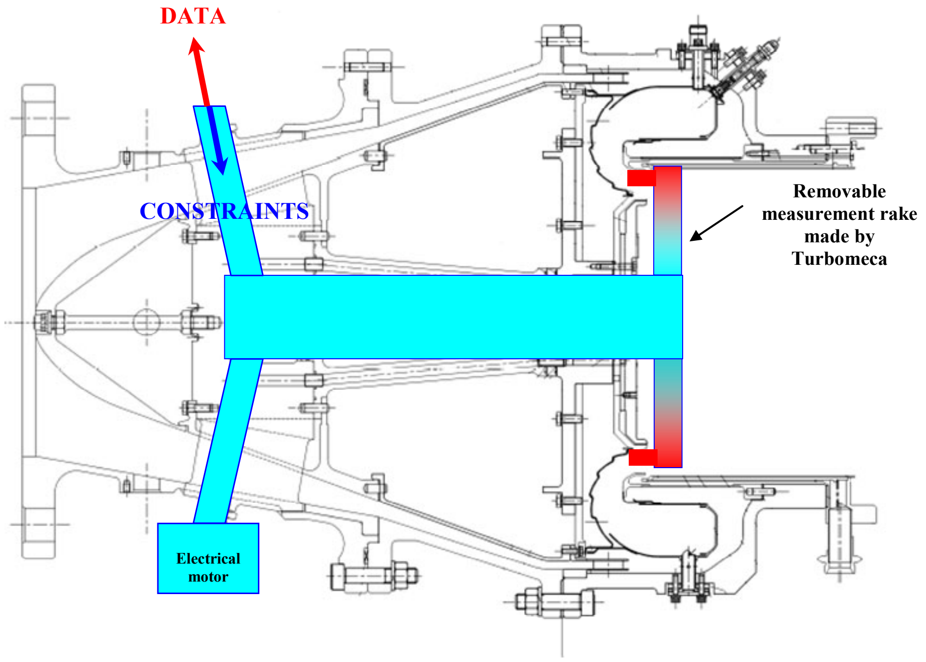


Figure 1: Schematic view of the internal rotating shaft (in blue) with to measurements rakes. The colour gives an indication of the temperature level in use from 500 K in blue to 1600 K in red.

The objective of this project consists in the development (detailed design, manufacture and test) of a device devoted to the test of small reverse-flow annular combustors allowing reliable and accurate measurements of gas concentration, temperature and velocity up to: T≈1600 K; P≈20 Bars, V ≈ 80 m/s.

The measurement device will be based on 4 easily removable rakes (supplied by ITD Topic leader) and assembled on a rotating shaft placed inside the combustor module and driven by an electrical motor. Probe displacement and data acquisition (temperature, gas concentration from analysers, pressures…) will be computer controlled. Simultaneously, average values of experimental conditions will be collect by the computer and gathered to instantaneous measurements.

Consequently, in such geometrical configuration (probe rakes embedded within the module), will make it adaptable to any test centre.

The project consists in the detailed design and the manufacturing of an embedded system (inside the module) which satisfies the following requirements :

- The rotating shaft is to be fitted with 4 measurements rakes, 2 for temperature measurements (typically 4 thermocouples each) and 2 for gas sampling, (1 at 5 discrete radii, and 1 averaged),
- Rakes must be easily removable,
- Minimum inner diameter of the combustor: 150 mm,
- Maximum shaft diameter: 60 mm,
- Shaft length : approximately 400 mm,
- The analysis must be performed continuously (360° in 12 min) or step by step (angular resolution of 0.5 °); In this case, higher speed is allowed,
- The gas sample must be maintained at a constant temperature of 190 °C,
- The rotating system geometry has to remain compatible with the actual module dimensions and interfaces (flanges),
- Input (air and water cooling, drive mechanism of the shaft) and output (thermocouples, gas sampling tubes) will be performed trough the upstream casing arms (up to five),
- Thermal exchange with the incoming air flow must be as low as possible in order to avoid

dissymmetry at the combustor entry.

These constraints lead us to point out several key points :
The proposal will be evaluated on the base of firstly the fulfilment of the constraints above and secondly of the efficiency and efficacy of the proposed solution for:

- Shaft entrainment,
- Electrical rotating collector for thermocouples,
- Pneumatic rotating collector for gas samples,
- Temperature control (both cooling and heating),
- Acquisition and displacement software,
- Tightening,
- Integration of all functions according the compactness.

Work to be performed by the partner

The partner will be in charge of both hardware and software development of the device , in accordance with ITD Topic leader's device interfaces (gas analysis system, flanges, …) including :

- Drawing of the components, raw material procurement, manufacturing, assembly,
- Validation of innovative technical solution as proposed,
- Preliminary tests,
- Software specifically: displacement and data acquisition, first processing.

The validation of the device on real conditions will be carried out on ITD Topic leader test bench.

2. Special skills, certification or equipment expected from the applicant

This task can require several partners, exhibiting high and proven experience in the detailed design and the manufacture of test rig.
In case of response by several partners, at least one of the partners (the coordinator) must exhibit experience in the management of a consortium.
The activity will be managed with a Phase & Gate approach and management plan has to be provided. ITD Topic leader will approve gates and authorize progress to subsequent phases.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Detailed design		T0 + 4
D2	Parts machined with final dimensions		T0 + 10
D3	Tests en TM's Test bench.		T0 + 12

4. Topic value (€)

The total value of biddings for this work package shall not exceed
€ 200,000/00
[two hundred thousands euro]
Please note that VAT is not applicable in the frame of the CleanSky program

5. Remarks

As a general guide, it is foreseen that the length of proposals for this topic will be approximately **30 pages** (depending on the applicant's need to adequately explain the proposal).
In this context, please note also the instructions on minimum font and margin sizes and other matters in the document *"Rules for Participation and Rules for Submission of Proposals and the related Evaluation, Selection and Award procedures"*.

Clean Sky - Smart Fixed Wing Aircraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	**8**	**4.040.000**	**3.030.000**
JTI-CS-SFWA-01	Area01 – Smart Wing Technology		**2.140.000**	
JTI-CS-2010-3-SFWA-01-023	Design of Robust Shock-Control-Bumps for Transport Aircraft with Laminar-Flow Wings		350.000	
JTI-CS-2010-3-SFWA-01-024	Flight-tests with multi-functional coatings		150.000	
JTI-CS-2010-3-SFWA-01-025	Development of a closed loop flow control algorithm for wing trailing edge flow control including experimental validat		560.000	
JTI-CS-2010-3-SFWA-01-026	Power module using Silicon Carbide technology for DC/DC converter application		480.000	
JTI-CS-2010-3-SFWA-01-027	Deflection and structural health monitoring of composite wing movables driven by smart actuators		600.000	
JTI-CS-SFWA-02	Area02 – New Configuration		**1.900.000**	
JTI-CS-2010-3-SFWA-02-007	Wind Tunnel Model Design for Low Speed Test with Active Flow Control		250.000	
JTI-CS-2010-3-SFWA-02-008	Numerical and experimental aero-acoustic assessment of installed Counter Rotating Open Rotors (CROR) power plant		200.000	
JTI-CS-2010-3-SFWA-02-009	Model design & manufacturing of the turbofan configuration for low speed aerodynamic and acoustic tests		1.450.000	
JTI-CS-SFWA-03	Area03 – Flight Demonstrators			

Description Sheet

CfP Nr.	Title		
JTI-CS-2010-3-SFWA-01-023	**Design of Robust Shock-Control-Bumps (SCB) for Transport Aircraft with Laminar-Flow Wings**	Start Date	*01 Nov 2010*
		End Date	*31 Dec 2013*

1. CfP Description

1.1 Short description

Laminar wings feature extensive regions with favourable pressure gradient that yield high pre-shock Mach-numbers and shock strength in the transonic regime. The availability of efficient shock control techniques is therefore highly desirable for future laminar aircraft. *Shock control bumps (SCBs*) are considered as a promising passive shock control technique and shall be investigated in the present project. The focus is on the design of robust (i.e. drag reducing over a large range of free stream conditions) non-adaptive SCBs for transonic wings and the assessment of the expected benefit. A *RANS (Reynolds averaged Navier-Stokes flow solver)* based process chain for the design of robust SCBs shall be developed. Subsequently, experimental and numerical studies on flow physics and aerodynamic effects of SCBs shall be conducted that lead to a proposition of a basic bump shape for enhanced robustness on laminar wings. Finally, an assessment of the overall benefit for a generic aircraft with laminar wing has to be conducted for a realistic flight mission.

1.2 Scope of work

Task 1: RANS based process chain for robust SCB design

A process chain shall be established that allows the design of parameterized SCBs for given input parameters such as wing shape and free stream conditions. The performance of a given design must be evaluated with a 3D-RANS calculation and a design loop shall be established so that an optimum for the specific task can be found. The CFD chain shall be qualified for the prediction of the SCB aerodynamics.

Task 2: Experimental and numerical studies on flow physics

The complex flow around a 3D-Bump shall be subject to detailed investigations. Depending on free stream conditions and on rear and side flank shape of the bump, a tendency to flow separations may occur. Because three-dimensional separation is difficult to predict accurately with RANS solvers, parallel wind tunnel experiments shall be conducted for different bump shapes. The numerical and experimental studies shall also consider sweep effects with the SCB being exposed to cross flow components. In general, the experiments shall verify the prediction of the SCB flow physics.

Task 3: Optimum basic bump shape for laminar wings

Taking the results of the flow physic studies into account, a low degree of freedom parameterization for the optimum basic bump shape for the use on laminar wings shall be developed. This basic shape shall be robust enough that it can be used for a broad variety of airfoils and free stream conditions. This basic shape should be used as a starting point for a specific case optimisation following the procedures developed in Task 1.

Task 4: SCB design guidelines

A report shall be provided that summarizes the most crucial SCB design parameters and describes their effects. Handbook-like simplified design rules shall be derived that give reasonable estimates for the main SCB design parameters. The investigations shall include recommendations for the SCB design conditions relative to the drag curve of the baseline wing. It is essential that this guideline is valid for any realistic transport aircraft concept with natural laminar flow wings.

Task 5: Assessment of the benefit for a generic transport aircraft

The overall benefit of optimized SCBs on a generic transport aircraft with laminar flow wings shall be estimated by using the process chain developed in Task 1. A representative long haul mission and the varying free stream conditions must be taken into account and the gain in maximum range shall be assessed.

2. Special Skills, certification or equipment expected from the applicant

- Sound background in numerical simulation of steady and unsteady transonic viscous flow including separation.
- Experience in application of CFD methods to the simulation of aircraft aerodynamics.
- Long term experience in research on passive flow control, in particular shock and separation control.
- Expertise in research on the flow physics of shock control bumps.
- Expertise in design and assessment of shock control bumps.
- Experience in CFD-based numerical optimization (and assessment of parameterization techniques).
- Access to high performance computers.
- Availability of wind-tunnel facilities and adequate measurement techniques for fundamental experimental studies on SCB flow physics.

3. Major deliverables and schedule

Ref. Nr.	Title	Description	Due date
D1.1.1-03-01	RANS based process chain for SCB design and validation	Report	31.10.2011
D1.1.1-03-02	Numerical and experimental investigations on robust SCBs and preliminary design guidelines	Report	30.04.2012
D1.1.1-03-03	Validation of robust SCBs and detailed numerical and experimental studies of the flow physics	Report	31.12.2012
D1.1.1-03-04	Design guidelines for robust SCBs	Report	31.12.2012
D1.1.1-03-05	SCB design for generic laminar wing aircraft and final assessment of the benefit	Report	31.12.2013

4. Value of CfP workpackage

The total value of biddings for this work package shall not exceed

€ 350.000,--
[three hundred fifty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

5. Estimated spend profile [KEuro]

2009	2010	2011	2012	2013	2014	2015
0	20	125	125	80	0	0

6. Remarks

- All core activities have to be performed by the organisations(s) submitting the proposal. A consortium with more than one organisation with stated expertise may apply. Subtasks can be subcontracted. The subcontracted tasks have to be clearly indicated and justified. The expertise of the subcontractor has to be documented.
- The applicant(s) should have experience in participation of European research projects and shall prove their expertise in the field of shock control by a list of reviewed publications.
- As an indication, the expected length of the technical proposal is between 15 and 20 pages

Topic Description Sheet

CfP Nr.	Title		
JTI-CS-2010-3-SFWA-01-024	**Flight-tests with multi-functional coatings**	Start Date	01.01.2011
		End Date	31.12.2011

1. CfP Description

The subject of this CfP are flight-tests with multi-functional coatings applied to the surface of on the aircraft. The areas, where the coatings can be applied, are the leading edge, the upper and lower cover of the wing, the horizontal tail plane (HTP) and the fuselage. The coatings, which essentially shall support natural laminarity of the flow, will be developed as part of the SFWA-ITD project.
The purpose of this CfP topic is to find an airline, which is interested in conducting the tests during commercial aircraft operation. The application and de-application of the coatings will be done by ITD Topic leader. Approximately 6 coating-patches will be each applied on 2 aircrafts. The patches will have a maximum size of 300 mm x 300 mm. The aircrafts shall fulfil the requirements below and should be operated also in Asia and India. A documentation of the number of flight hours, flight cycles and weather conditions has to been done. The test will last 12 month. During the test duration 5 inspections shall be done. The inspection has to been done by a replica impression (will be provided by ITD Topic leader), by photos or by roughness measurements and has to be reported during the test. A training for the inspection can been done by ITD Topic leader when applying the coatings. A photo/video observation of the test area on ground/during flight should be considered as well.

This innovative method flight-tests are necessary to evaluate the performance and degradation of new sophisticated, multi-functional coatings during in-service. Activities related to achieve flight clearance or airworthiness will be heavily supported by the SFWA-ITD members.

2. Special Skills, certification or equipment expected from the applicant

- The applicant has to operate aircrafts which fulfil the following requirements during flight:
    - Cruise velocity: typical short range / long range values
    - Cruise height: typical short range / long range values
    - PAX: up to 300
- The applicant have to report the flight-conditions during the flight-tests (flight hours, flight cycles, weather conditions)
- The applicant shall have an MRO in Europe to apply the different coatings
- The applicant shall operate also in Asia/India
- The applicant has to have some technician or engineer to do a scientific evaluation (as described above; one training possible)
- The applicant has to have a device for roughness measurement according to ISO 4287

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D1.1.3-01-01	Application of coating	Application of coatings; beginning of October planned depending on availability of airplane and coating	01.02.2011
D1.1.3-01-02	1st inspection	1st inspection of the coatings have to been done and data provided	01.03.2011
D1.1.3-01-03	2nd inspection	2nd inspection of the coatings have to been done and data provided	01.04.2011
D1.1.3-01-04	3rd inspection	3rd inspection of the coatings have to been done and data provided	01.06.2011
D1.1.3-01-05	4th inspection	4th inspection of the coatings have to been done and data provided	01.09.2011
D1.1.3-01-06	5th inspection	5th inspection of the coatings have to been done and data provided	01.12.2011
D1.1.3-01-07	De-application of the coatings	In agreement with airline	18.12.2011

4. Value of CfP workpackage

The total value of biddings for this work package shall not exceed

€ 150.000,--
[one hundred fifty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

5. Estimated spend profile

2009	2010	2011	2012	2013	2014	2015
0	0	150	0	0	0	0

6. Remarks

None

Clean Sky Joint Undertaking
JTI-CS-2010-3-SFWA-01-025

European Commission
Research Directorates

Topic Description

Topic Nr.	Title		
JTI-CS-2010-3-SFWA-01-025	**Development of a closed loop flow control algorithm for wing trailing edge flow control including experimental validation in two low speed wind tunnel tests**	**Start Date**	01.11.2010
		End Date	31.12.2012

1. Topic Description

Subject of this topic is the development and demonstration of a closed loop flow control technique, which is optimised for an application of active flow control at a wing trailing edge flap, designed for such an application. The active flow control should consist of matured pulsed flow control techniques applied through span wise segmented slots implemented on the leading edge region / shoulder of a typical single slotted flap. It is required, that robust fluidic actuation systems will be applied within a closed-loop flow control architecture making use of a wind tunnel with mid-size dimensions (i.e. suitable for models with typical dimensions as described below). The functionality of the pulsed flow control actuation system has to be proven ahead of the wind tunnel tests in which the approach should be validated.

The closed loop methods shall be developed in two directions:

1) A pre-modelled algorithm approach which would allow calibrating the algorithm for each full scale aircraft application in a single full scale calibration flight (i.e. one pre-test in flight) which delivers the right coefficients or parameters (for the flow control system) to be used throughout the flight mission of the airplane (civil transport aircraft assumed here). The algorithm development is devoted for future use in flight test activities.

2) An adaptive algorithm approach employing a generic closed loop model which will be adjusted in a “learning by doing” system. This approach should lead to the same robust, effective and predictable algorithm as the pre-modelled one. This approach has to be proven in experimental tests.
A mid scale wind tunnel model with a clean chord of 0.6 m, a span of about 2.4 m and a flap chord of about 30% has to be used for the wind tunnel testing including suitable fluidic actuators. Such a model based on F15 geometry (DLR nomenclature) will be made available (DLR model). The wind tunnel tests are planned for 2011 and possibly 2012, so the concept definition, design and possibly simulation should be done before.

The wind tunnel tests (see M03) have to be done in a suitable facility able to facilitate active dynamic flow control techniques (i.e. pressurized air supply for fluidic actuators). It is estimated that two test campaigns are needed, each covering about 10 days including set-up, rigging and measurements. Within the first measurement campaign the focus is on the control loop with pre-modelled algorithm approach with active flow control application on the flap. The second campaign focuses on verification of both approaches.

The applicant has to demonstrate the readiness for the mid-scale test by pre-tests in their own facility. These pre-test could be conducted on a two-dimensional (2D) set-up and preferably by using the same F15 geometry.

Further requirements:

- Experimental investigation between Ma=0.15 and 0.25
- Provision of pressurized air supply and measurement techniques
- Detailed analysis of the results is mandatory: for each test campaign a technical report has to be produced
- Sensors and/or fluidic actuators integration into the provided model/flap has to be done by the applicant
- The applicant should demonstrate that the sensor integration can be done with a minimum of impact on the quality of the model/flap (maintain contour and surface quality)
– The mid-scale F15 model will be provided

2. Special Skills, certification or equipment expected from the applicant

- The applicant should have a sound R&T background in design, testing and demonstration of flow control techniques in small and mid scale wind tunnel facilities on own wind tunnel models, preferably on F15 geometry wind tunnel models.
- The applicant is able to integrate sensors and fluidic actuators in a wind tunnel model, can manufacture add-ons of devices and testing of systems for flow control applications in wind tunnels.
- The applicant has to have laboratory testing facilities and equipment necessary for fluidic actuator functional testing.
- The applicant has expertise in the design and application of closed loop algorithm esp. in the aerodynamic environment
- The applicant has to show expertise in modelling and optimisation.
- The applicant has to provide support for the operation in upper-coordinate tests.
- All tools for a detailed design process and simulation must be available at the applicant.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D01	Concept Report	Description of flow control means for aerodynamic wind tunnel tests.	01.03.2011
D02	Pre-tests with closed loop flow control and optimised flap design	Wind tunnel tests on 2D/2.5D mid scale wind tunnel model conducted and analysed.	15.05.2011
M01	Critical design review	Design review of application of closed loop flow control means for optimised flap design incl. implementation concept for mid scale tests.	15.06.2011
M02	Ready for mid scale 2.5D tests	Integration of flow control actuator techniques, closed loop techniques. Test readiness review.	15.08.2011
M03	2.5D wind tunnel tests conducted and analysed	Performance of final wind tunnel tests with flow control on 2.5D F15 model conducted in a mid scale wind tunnel facility, and provision of results from the two proposed campaigns.	31.03.2012
D03	Exploitation report for large scale model test	Exploitation of test data and results for preparation of large scale wind tunnel test in a large scale facility and high Reynolds number testing.	15.05.2012
D04	Final report.	Final technical report about results and project closure.	15.12.2012

4. Topic value (€)

The total value of biddings for this work package shall not exceed

€ 560.000,--
[five hundred sixty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program.

5. Estimated spend profile

2009	2010	2011	2012	2013	2014	2015
0	20	260	280	0	0	0

6. Remarks

No further remarks.

Topic Description Sheet

CfP Nr.	Title		
JTI-CS-2010-3-SFWA-01-026	**Power module using Silicon Carbide (SiC) technology for DC/DC converter application**	Start Date	**01.12.2010**
		End Date	**15.12.2012**

1. CfP Description

The subject of this call for proposal topic is the development of SiC power module for DC/DC converter to provide a HVDC (High voltage direct current) +/-270 VDC network for flight actuators which will be supplied by SAGEM. This development will be part of the electronic hardware delivery for validating the electrical architecture of the flight control used on an aircraft test rig. However, the module to be developed shall be compliant with the aircraft operational environment.

The requested development covers the design, manufacturing & qualification phases. The definition of this module will be industrial.

The design will use a build in reliability approach in order to be sure that the module will fit with reliability requirements.

The purpose of this CfP topic is to assess if SiC is mature according to aircraft environment (reliability issue)

2. Special Skills, certification or equipment expected from the applicant

- The applicant has to have a full ISO 14001 certification
- The applicant has to access to Silicon Carbide technology
- The applicant has to master all processes to apply “Design to reliability” approach
- The applicant has to have a manufacturing line to assembly the power module
- The applicant has to develop dedicated tests means to test the module in DC/DC conversion application
- The applicant has to have relevant tests & qualification means to characterize the power module

3. Major deliverables and schedule

Ref. Nr.	Title	Description (if applicable)	Due date
D1.3.3.3-01-01	Preliminary design report		TO + 3
D1.3.3.3-01-02	Design report		TO + 8
D1.3.3.3-01-03	Validation report (phase 1)	Electrical tests part	TO + 14
D1.3.3.3-01-05	Power module delivery	Delivery to Airbus (Quantity = 10)	TO + 14
D1.3.3.3-01-04	Validation report (phase2)	Electrical + qualification tests	TO + 24
D1.3.3.3-01-06	Reliability tests report	Complete reliability assessment	TO + 24

TO = start of the contract

4. Value of CfP workpackage

The total value of biddings for this work package shall not exceed **€ 480.000** **[four hundred eighty thousand euro]** Please note that VAT is not applicable in the frame of the *CleanSky* program

5. Estimated spend profile [kEuro]

2009	2010	2011	2012	2013	2014	2015
0	20	240	220	0	0	0

6. Remarks

The Silicon carbide technology is presented as the breakthrough technology in the coming years for the power electronics and this technology enables the weight and volume improvements allowing high levels of integration and to achieve an increase modularity of electrical power conversion. For Airbus, this technology is a key technology for power electronics to support the evolutions of aircraft systems towards more electrical solution (flight control actuators, electrical environmental control system, electrical architecture …). Airbus may answer effectively to the new requirements in power electronic designs in terms of reliability, availability, maturity, robustness and safety and to decrease development cycles and recurrent costs

Topic Description Sheet

CfP Nr.	Title		
JTI-CS-2010-3-SFWA-01-027	**Deflection and structural health monitoring of composite wing movables driven by smart actuators**	Start Date	1.12.10
		End Date	30.11.12

1. CfP Description

The aim of this CfP topic is to develop a system including algorithm and sensors able to

a) monitor the deflection of model wing components driven by piezo-electric/shape memory alloy – based composite actuators in order to close the loop of a control system, and
b) provide structural health monitoring in terms of damage detection of these wing components,

thereby enabling the set up of a multifunctional monitoring system.

The CfP topic will directly support the work conducted by Delft University of Technology (DUT) within SFWA ITD in developing actuation systems based on piezoelectric materials and shape memory alloys (SMAs), Figure 1.
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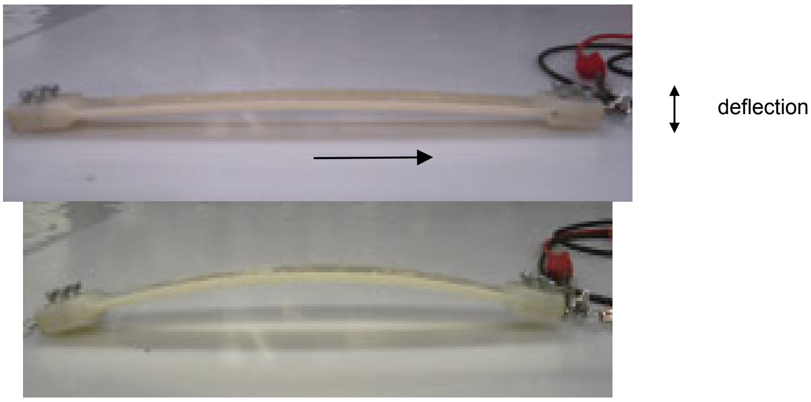


Figure 1: Example of a simple composite bender before actuation (left) and after (right); the piezoelectric materials used are ceramic patches (PZTs) that we may embed in a composite panel and, through application of an electric field, can force the panel to distort. The shape memory alloys are in the form of wires, that when embedded, can produce the same effect. Depending on the actuation material, precise movements can be achieved and potentially large forces can be taken, which makes these materials attractive for actuation.

Expanding on the aim above:

a) Deflection measurement: DUT is developing a complete integrated system including the actuation, the structure to be actuated, the control unit and the relevant sensing devices. An example of a possible system is shown in Figure 2. As the project focuses on composite-based structures, it is necessary to involve deformation measuring and structural health monitor tools at an early stage in the design. In this way we are able to correct for any structural implications during the system integration work.

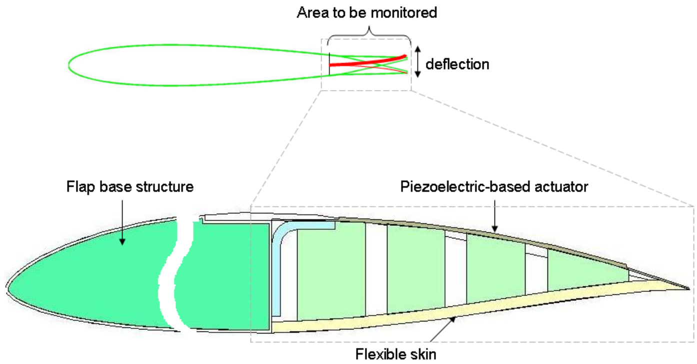


Figure 2: A modified wing flap with a deformable trailing edge

b) Damage detection: The CfP topic also requires the development, assessment and optimisation of a damage detection technique for monitoring, on-or off-line, the integrity of the actuated area using the same sensor system.

SMA- and PZT- based composite actuators can be used in a number of ways, however we are interested in usage for deformable surfaces. These deformations will be in the form of deflections such as those shown in Figures 1 and 2. A variety of frequencies is possible, and depends on the size of the area to be actuated. As a very rough guide, these frequencies can reach up to 100Hz, however we are interested in online monitoring of deflections up to 15Hz. The CfP also requires the development, assessment and optimisation of a damage detection technique to monitor, on-or off-line, the integrity of the actuated area using the same sensor system.

As the TRL of the actuators currently under development are low, it is expected that a partner can provide a monitoring system that is reasonably mature (TRL 4 or higher) such that we may minimise error in the experiments.

The sensor shall be provided by the applicant. The various composite specimens shall be manufactured by the DUT, and proof of concept shall be performed through experimental tests. The test specimens have the details as follows

Coupon tests	
Material	Carbon-fibre and glass-fibre epoxy flat plate laminates
Thickness	From 0.5mm to 2mm
Dimension	(70x20)mm minimum (300x300)mm maximum
Number of specimen	Made as necessary
Wing subcomponent test	
Type	Trailing edge flap device
Material	Carbon fibre- and glass fibre- epoxy sandwich construction likely
Dimension	50cm chord length, 10cm deformable chord, up to 1m flap length
Number of flap devices	2 whole constructions maximum

The applicant shall develop 3D numerical models that shall calculate the expected output of the sensors as a result of the structural deformations/deflections due to the actuators.

These models shall also show how damage can be detected due to, for example, impact. The experimental stage will consist of a proof of concept of the monitoring system, system tests with simple coupons exposed to mechanical loads and finally system tests of wing subcomponents.

Based on these results, an algorithm has to be developed for accurate deflection and shape reconstruction due to monitored deformations.

2. Special Skills, certification or equipment expected from the applicant

- The applicant shall have a technology rated at TRL 4 or higher.
- The applicant shall own a calibrated laboratory test monitoring unit
- The applicant should have sound knowledge of composite materials/structures
- The applicant shall own, or have access to, all numerical and experimental tools necessary for this project

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D1.3.9-01-01	Requirements phase	Requirements document as defined together with the topic manager	01.02.11
D1.3.9-01-02	Concept set-up	Concept report	01.03.11
D1.3.9-01-03	Modeling phase	Preparation to final reporting of 3D models to describe sensor/structure interaction, predict structural deformations/deflections and expected outputs from sensors	01.06.11
D1.3.9-01-04	Sensor placement and resolution	Report of experimental testing relating to sensor resolutions, locations and quantity, confirmation of 3D model.	01.09.11
D1.3.9-01-05	Test report of sample sensor	Test coupon manufacturing and sensor installation and calibration. Validate test coupons with integrated sensor network for both deformation and damage detection	01.12.11
D1.3.9-01-06	Report of full testing of simple coupons for damage detection	Report of test results of (flat plate) coupon and sensor networks subjected to structural imperfections	01.04.12
D1.3.9-01-07	Report of full testing of simple coupons for deflections	Report of test results of (flat plate) coupon and sensor networks subjected to mechanical loads	01.04.12
D1.3.9-01-08	Report of full testing of subcomponent for damage detection	Report of test results of subcomponent and sensor networks subjected to structural imperfections	01.09.12
D1.3.9-01-09	Report of full testing of subcomponent for deflections	Report of test results of subcomponent and sensor networks subjected to mechanical loads	01.09.12
D1.3.9-01-10	Algorithm development	Algorithm development for deflection and shape reconstruction due to deformations	30.11.12

4. Value of CfP workpackage

The total value of biddings for this work package shall not exceed

€ 600.000,--

[six hundred thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

5. Estimated spend profile [kEuro]

2009	2010	2011	2012	2013	2014	2015
0	25	200	375	0	0	0

6. Remarks

The majority of the experimental work and project meetings are expected to take place at the ITD Topic leader

Topic Description Sheet

CfP topic number	Title		
JTI-CS-2010-3-SFWA-02-007	**Wind Tunnel Model Design for Low Speed Test with Active Flow Control**	Start Date	January 2011
		End Date	January 2012

1. Topic Description

The subject of this CfP topic is the design of a large scale Wind Tunnel Model intended for Low Speed (Mach ~0.20) Wind Tunnel Testing with Active Flow Control (AFC) capability. This test will permit to validate AFC technology planned for both Airbus & ITD Topic leader next generation short range and long range aircraft.

This call item concerns only the design of the model. Manufacturing of the different model parts will be addressed in a separate call item in the Clean Sky Call for Proposals in June 2010.

The model will eventually contain three main parts:

- An existing fuselage provided by ITD Topic leader Aviation,
- A low sweep wing, typically 20-25°
- A high sweep wing, typically over 30°

The model shall be a "half-model", side mounted on the wall of the wind tunnel. As the fuselage already exists, model scale is set. It is approximately 1/5 for a typical Business Jet.

The model shall be compatible with large scale Wind Tunnel Facilities. This includes both atmospheric and pressurized wind tunnels. Therefore, the model shall resist loads induced by a high pressure environment (up to Pi = 4bar). Maximum loads expected are:

- Rn = 3200 daN (normal load)
- Ra = -650 daN (upstream)(axial load)

The applicant will be expected to explore, with the SFWA team, innovative solutions as indicated in the description following below. This concerns the model design with active flow control (high pressure air crossing interfaces, component load decoupling …), as well as measurement techniques (for example: dynamic flap loads, LE component loads …).

1.1 Fuselage

The existing fuselage is compatible with a half-model mounting in the ONERA F1 facility. While maintaining this capability, the fuselage has to be modified to integrate an AFC capability. Fuselage modifications shall be reversible allowing restoration of the initial model testing capabilities. Provisions should be foreseen to provide the wing with high pressure air and possibly electrical power.

1.2 Actuator definitions and integration requirements

Actuators are sized, designed and evaluated in a parallel SFWA Work Package (WP1.1.4: High Lift & WP1.3 Actuators & Sensors). The actuator concepts to be integrated will come from former studies.

For this experiment flow control may include:

- Synthetic Jet (for both wing or flap leading edge)
- Pulsed fluidic vortex generators for upper or lower wing

Electrical power, pneumatic pressure or general volume requirements will be provided in later documents (Model Requirement Document in autumn 2010)

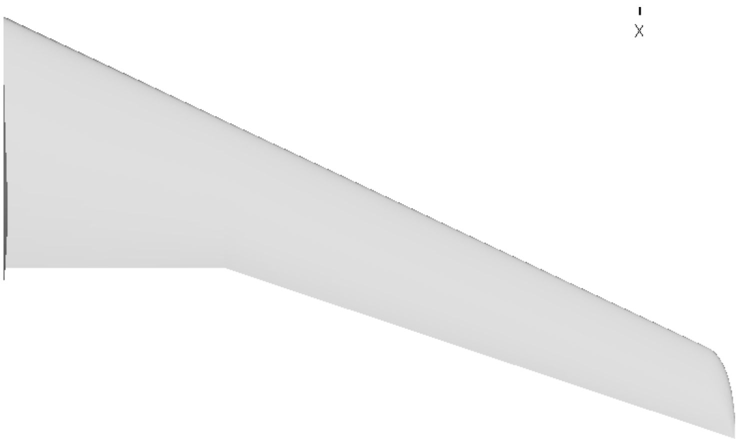
1.3 Wings
One low sweep and one high sweep have to be designed, both with AFC capability. They will alternatively be mounted on the same fuselage provided by ITD Topic leader. The shape of both wing and the high-lift system definition (flap & slat geometries) will be provided by ITD Topic leader to the applicant.

1.3.1 Low Sweep Wing
The Low sweep wing is typically a high aspect ratio plan form (AR~9-12), with quarter-chord-sweep around 20-25°.
Airfoil shape is driven by the pressure distribution required to achieve Natural Laminar Flow at cruise condition. Typical relative thicknesses for such airfoils are 10-15%. The final model geometry will be supplied as part of the Model Requirements Document, Autumn 2010.

Wing Leading Edge could be with or without slat. The wing needs to be modular, in order to allow several technologies to be tested.

Required modularity is as follows:

- Removable Leading Edge with AFC (approximately 15% chord). The model will allow different mechanical or pneumatic high-lift devices to be fitted on the Leading Edge. The model will be able to provide LE with high pressure air and possibly electrical power as required by the AFC actuator(s). The LE will be split in several parts in span to allow a high level of modularity.
- Trailing Edge (TE) flap with AFC. The model will be able to provide the TE flap(s) with high pressure air and possibly electrical power as required by the AFC actuator(s)
- Removable wing tip. This could permit different active wingtips/winglets to be fitted if needed.



Typical Low Sweep High Aspect Ratio Wing design(in clean configuration)

1.3.2 High Sweep Wing
The high sweep wing to be designed will typically have a moderate aspect ratio plan form (AR~5-9), with quarter-chord-sweep above 30°.

Airfoil shape is driven by pressure distribution required in the high transonic regime (Mach>0.8), also known as "supercritical" airfoil. Typical relative thicknesses for such airfoils are 8-13%

The requirements for this wing are the same as the ones for the low sweep wing.

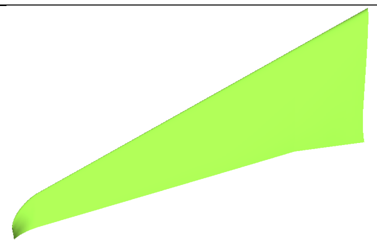


Figure: Typical High Sweep Wing (in clean configuration)

1.4 Loads & instrumentation

- External Loads: the model shall be able to sustain max total pressure met in the various tunnels (typically Pi~3.8 bars from ONERA F1 requirements).
- Internal Loads: the model shall be able to sustain high pressure internal ducts required by Active Flow Control actuators.
- Force measurements could be measured in several ways.
    - external wall balance mounted in the fuselage, as existing for Onera F1; testing in another facility would probably require another balance to be selected and adapted to the model
    - Loads measurement through static pressure lines across span, or using local component balance on the flap.
- Model instrumentation shall consist of static pressure measurements. Baseline scenario (i.e. with external balance to measure aerodynamic forces) would typically require 5-10 different stations in span, each featuring 20-30 taps.

Details on loads and balance will be defined in the Model Requirements Document. (autumn 2010)

2. Special Skills, certification or equipment expected from the applicant

- The applicant shall have a large experience in **designing and manufacturing** Wind Tunnel Models for the aeronautical industry.
- The applicant shall comply with ITD Topic leader Aviation procedures concerning WT model design and manufacturing. This will be provided in the model requirement document to be issued in autumn 2010.
- The applicant shall have confidential agreement(s) with all partners participating in the Low Speed Platform.
- Model definition will be provided in Catia Definition. Therefore, the applicant shall have proficiency in using ITD Topic leader System CATIA Software. .

3. Major Deliverables and schedule

Deliverable	Title	Description	Indicative Due date
D2.1.3-01	Wind Tunnel Model Description		January 2011
D2.1.3-02	Wind Tunnel Model CAD File for Fuselage and Low Sweep Wing	File Format : Catia V6 (TBC)	March 2011
D2.1.3-03	Wind Tunnel Model Loads and Stress Justification: Fuselage and Low Sweep Wing		June 2011
D2.1.3-04	Wind Tunnel Model CAD File for High Sweep Wing	File Format : Catia V6 (TBC)	September 2011
D2.1.3-05	Wind Tunnel Model Loads and Stress Justification: High Sweep Wing		January 2012

5. Topic value (€)

The total value of biddings for this work package shall not exceed

€ 250.000,--
[two hundred fifty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

6. Remarks

The flow control systems and strategies are currently evaluated in different national & European studies with less integrated models as a step by step approach (for example in 2D, 2D with sweep low speed facilities) to ensure a real efficiency of the concepts. Only promising and realistic (in term of aircraft integration) will be tested. If finally, no concepts emerge as promising, the scope of the high Reynolds wind tunnel test will be redefined for extensive mechanical novel high lift device experiment (smart flap concepts studied in SFWA WP1.1.4 "High-Lift Devices").
In the same way, if no actuators are to be integrated to the wings, the model will be full on another existent fuselage (1/8 scale) provided by ITD Topic leader.

Topic Description Sheet

CfP Nr.	Title		
JTI-CS-2010-3-SFWA-02-008	**Numerical aero-acoustic assessment of installed Counter Rotating Open Rotor (CROR) power plant**	Start Date	**01.11.2010**
		End Date	**31.12.2012**

1. CfP Description

SFWA task n. WP2226 is concerned with the assessment of the aero-acoustic impact of Counter Rotating Open Rotor (CROR) engines. This is done numerically and experimentally on isolated and installed test geometries at low and high speed conditions. CFD/CAA (Computational Aero Acoustics) assessment prior and posterior to tests (performed in task 2.2.2.5: Installed CROR characterisation) shall be performed, as well as comparison to some existing wind tunnel test data for selected test points.

CFD/CAA assessment methods used within this WP are :
- 3D steady state mixing plane method
- 3D unsteady chorochronic method
- 3D URANS chimera method

The aim of this CFP topic is to complete the above proposed methods by additional aero-acoustic numerical installed CROR assessment methods with competitive computational accuracy/time ratio.

The work to be performed by the applicant consists of CFD simulations and post-processing of open-rotor flows, coupled with numerical analysis of flow-generated noise sources. The near-field and far-field noise has to be evaluated using acoustic propagation methods. Six to eight numerical predictions using applicant proposed CFD and CAA method, will have to be performed to cover parametric effects (angle of attack, configuration change and Mach number).

The starting point of this study will be the reference CROR configuration (based on a generic Airbus blade design) and some wind tunnel test model geometries, which will be provided to all WP partners and the applicant.

2. Special Skills, certification or equipment expected from the applicant

- High level working experience in CFD/CAA assessment of turbo machinery / propeller aerodynamics / acoustics
- Very good knowledge of propeller physics (aerodynamics & acoustics)

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date (indicative)
D2.2.2.6 - 01	Report	Pre-test CFD/CAA evaluation of isolated / installed CROR configuration	31.10.2011
D2.2.2.6 - 02	Report	Post-test CFD/CAA evaluation of isolated / installed CROR configuration	31.10.2012

4. Value of CfP workpackage

The total value of biddings for this work package shall not exceed :

€ 200.000,--
[two hundred thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

5. Estimated spend profile

2009	2010	2011	2012	2013	2014	2015
0	20	100	80	0	0	0

Topic Description Sheet

CfP Nr.	Title		
JTI-CS-2010-3-SFWA-02-009	**Model design & manufacturing of the turbofan configuration for low speed aerodynamic and acoustic tests**	Start Date	01.01.2011
		End Date	01.04.2012

1.1 - General Description

The subject of this topic is the design and manufacturing of an aircraft model for low speed wind tunnel tests at atmospheric pressure.

Both the configuration and testing technics will be innovative (see Figure 1). Large number of steady and unsteady mesurement probes are to be integrated in the very thin empennage and nacelle. Also a realistic IPPS simulator will have to be integrated in an innovative design. Finally, both aerodynamics and acoustic measurements will have to be done using the same model.

The model has to be designed in order to accommodate two turbofan simulators (7.8" VHBR turbofan simulators owned by DNW/ONERA) on the rear fuselage. A set of wings allowing for different configurations (clean, take-off, landing, airbrakes on/off) need to be designed and manufactured. One empennage (most probably U-shaped) needs to be built and equipped with steady and unsteady pressure transducers. It needs to be equipped with movable elevators and rudders. In addition, the empennage has to be modular in order to allow different empennage shapes, which in turn will make it possible to investigate various strategies for aerodynamic behavior and noise shielding. A set of nacelle and pylon capable of the turbofan are to be designed and manufactured in this current CFP.

All these different parts are to be equipped with pressure and Kulites probes as defined below.

The front part and other parts (to be defined in the coming months via the preliminary technical requirements) of the model will be designed and manufactured by another partner outside of the scope of this CFP.

1.2 - Model and Test description

1.2.1 - Wind-Tunnel test description

The objective of these Wind Tunnel campaign is to test a high-efficiency configuration studied in the scope of SFWA WP2.1. Focus is put on the design to improve environmental footprint of such an aircraft. In terms of aerodynamics, the design of the current project has been driven by:

- Effective Low Sweep High Aspect-Ratio wing with a representative laminar extension. This objective is demanding in term of low speed configuration design to maintain good take-off & landing performances & handling qualities. In addition with a classical low speed wind tunnel test, is also needed a characterization of such an effective wing in ground effect.

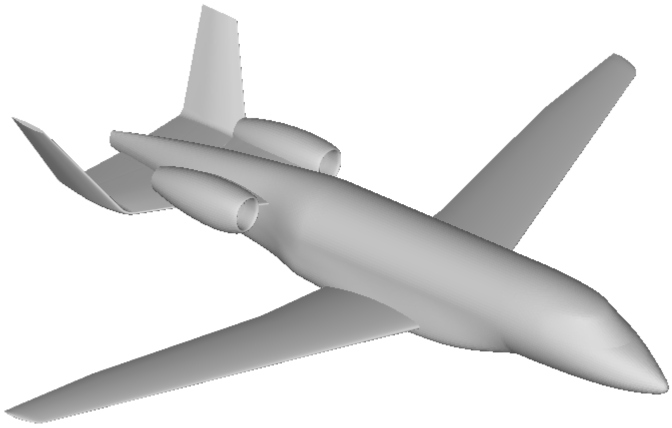


Figure 1: General View of the model preliminary design with its high aspect ratio wing

- Innovative Horizontal Tail (HT) configuration designed as engine noise shield (for both jet and turbine). The acoustic reduction effectiveness of this configuration has to be studied in a dedicated wind-tunnel test to consolidate the possible gain of these new HT. Additionally, the principal characteristic of such a drawing is a possible interaction between engine exhaust jet and horizontal stabilizer. This leads to a necessary study of the behaviour of this unusual situation in term of aerodynamic and flight characteristics.

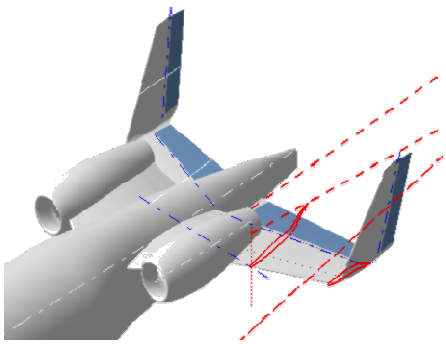


Figure 2: U-Fit Masking Tail (Jet above HT)

Therefore, principal aims of the Wind Tunnel Tests planned with the model specified in this CFP are to check the effectiveness and viability of design choices both in terms of aero acoustics and low speed characteristics. The future Wind Tunnel Test is planned as :

- a dedicated aero-acoustic campaign with turbofan in a wind tunnel capable of such test
- a dedicated low speed campaign with turbofan with and without ground effect in a wind tunnel capable of such test

This current CFP deals only with the design and manufacturing of the model that will be used in that future Wind Tunnel Test and not the test itself.

1.2.2 - Model description

The model size is driven by the need of integration of two turbofan simulators. These turbofan are 7.8" VHBR turbofan simulators owned by DNW/ONERA. This leads to a 1:5 scale (4m x 5m). General shape of the model is based on the LSBJ preliminary design. The parts of the model to be designed and manufactured in the field of this topic are:

- a set of wing allowing for different configurations (clean, take-off, landing, airbrakes on/off). The shape (airfoil definition, plan view, high lift devices and other control surfaces) will be specified by ITD Topic leaderto the applicant.

- a modular empennage (probably U-shaped). The shape (airfoil definition, plan view, elevator and rudder definition) will be specified by ITD Topic leaderto the applicant.

- a set of nacelle/pylon capable of intagrated the 7.8" Turbofan

1.2.2.1 - Wing Description

The Low sweep wing is typically a high aspect ratio plan form (AR~9-12), with quarter-chord-sweep around 20-25°.Airfoil shape is driven by the pressure distribution required to achieve Natural Laminar Flow at cruise condition. Typical relative thicknesses for such airfoils are 10-15%.

Wing Leading Edge could be with or without slat. The wing needs to be modular, in order to allow several technologies to be tested.

Required modularity is as follows:

- Removable Leading Edge (approximately 15% chord). The model will allow different removable leading edge shape definition for low speed testing. The model will also allow different high-lift devices to be fitted on the Leading Edge. The LE will be split in several parts in span to allow a high level of modularity. Typical slat to be designed for that model is so-called Kruger flap that enables the upper wing to be clean in a laminar point of view while increasing significantly low speed characteristics.

- Trailing Edge (TE) flap. The model will allow different set of flap (number of set of defined yet) to be tested in clean, Take-off (approximativally 20° flap deflection) and landing (approximativally 40° flap deflection) configuration. The trailing edge devices may be simple or double slotted flap with different extension achievable.

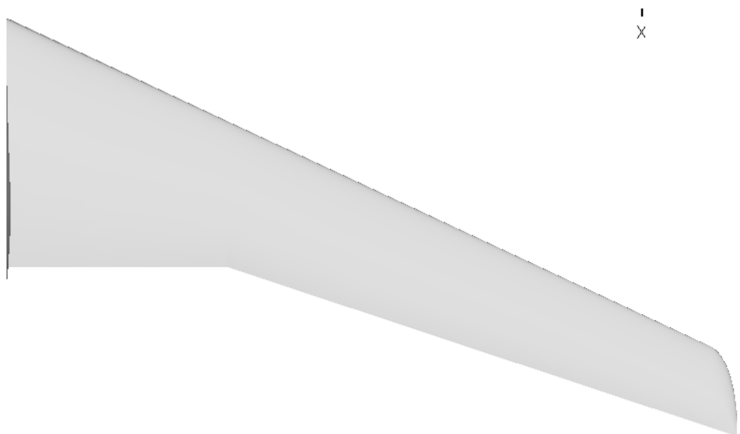


Figure 3: Generic high aspect ratio wing with laminar extension

- Removable wing tip. This could permit different active wingtips/winglets to be fitted if needed.

1.2.2.2 - Empennage Description

The Empennage is driven by acoustic noise reduction capacity. The planned configuration for this model is a U-shaped Tail that is composed of an horizontal plan that reduces turbine and probably jet noise in fly-over conditions and two symmetrically HT tip placed vertical tails to reduce lateral noise disturbance.

The model shall allow the possibility of testing the horizontal tail only, so the vertical part of the tail is to be removable. The incidence of the horizontal tail will vary during the test (trim capacity). Nevertheless, no motorized solution are asked for this CFP. Horizontal and vertical tail are to be equipped with movable control surface (elevator, rudder).

1.2.2.3 - Integrated Power Plant System

The model will be equipped with turbofan simulators to check both noise shielding and aerodynamics & flight characteristics with a blown upper part of the horizontal tail at low speed (take-off a landing conditions). The VHBR will be lent by the owners (ONERA/DNW) for these specific tests. Characteristics and integrations constraints will be provided to the applicant.

The applicant shall design and manufacture both nacelle and pylon parts of the model as specified by Dassault-Aviation.

1.2.2.4 - Other part of the Model:

The other parts of the model (forward and aft fuselage, engine nacelle & pylon) will be designed and manufactured by INCAS, partner of SFWA, outside of the scope of this CFP

1.2.3 - Model Specification

All the shape and interface definition of the model are defined and provided by ITD Topic leaderto INCAS and the applicant. Final geometry will be supplied in CATIA software definition in the Model Requirements Document to be issued in autumn 2010.

1.2.4 - Model equipment

Specific equipment are to be set in the model for test campaign. The different probes needed are:

- Kulites in the nacelle (inlet (several dozens) and nozzle) for acoustics
- Kulites and gauges on the empennage to estimate the loads

Position of different probe will be specified in the Model Requirements Document to be issued in autumn 2010.

Balances will be provided by the wind tunnel operator.

2. Special Skills, certification or equipment expected from the applicant

- The applicant shall have a large experience in designing and manufacturing Wind Tunnel Models for the aeronautical industry.
- The applicant shall comply with ITD Topic leader procedures concerning WT model design and manufacturing. This will be provided in the model requirement document to be issued in autumn 2010.
- The applicant shall have confidential agreement(s) with all partners participating in the Low Speed Platform.
- The applicant shall have proficiency in using Dassault System CATIA Software.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D2.2.4-S03-01	Complete model including instrumentation	According to detailed technical requirements	01.10.2011
D2.2.4-S03-02	Geometric inspection	According to the tolerance requirements	Before 01.12.2011
D2.2.4-S03-03	Instrumentation inspection	According to the technical requirements	Before 01.04.2012

4. Value of CfP workpackage

The total value of biddings for this work package shall not exceed

€ 1,450,000.—
[one million four hundred fifty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

5. Estimated spend profile

2009	2010	2011	2012	2013	2014	2015
0	0	1,160,000	290,000			

6. Remarks

None

Clean Sky - Systems for Green Operations

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	**13**	**7.250.000**	**5.437.500**
JTI-CS-SGO-01	*Area-01 - Definition of Aircraft Solutions and explotation strategies*		**0**	
JTI-CS-SGO-02	Area-02 - Management of Aircraft Energy		**4.500.000**	
JTI-CS-2010-3-SGO-02-019	Sample PEM construction for testing, characterisation and manufacturability assessment.		500.000	
JTI-CS-2010-3-SGO-02-020	Development of key technology components for high performance electric motors		250.000	
JTI-CS-2010-3-SGO-02-021	Development of key technology components for high power-density power converters for rotorcraft swashplate		250.000	
JTI-CS-2010-3-SGO-02-022	Fan noise reduction : study and realisation of a sub-assembly dedicated to new generation of Starter / Generator		200.000	
JTI-CS-2010-3-SGO-02-023	Development of current and voltage sensors suitable with aircraft environment		600.000	
JTI-CS-2010-3-SGO-02-024	Test bench for endurance test and reliability of avionics power electronic modules		800.000	
JTI-CS-2010-3-SGO-02-025	Definition and realisation of a field bus suitable for a multi-PEM (power electronic modules) ressource		500.000	
JTI-CS-2010-3-SGO-02-026	Modelica Model Library Development Part I		300.000	
JTI-CS-2010-3-SGO-02-027	Simulation and Analysis Tool Development Part I		400.000	
JTI-CS-2010-3-SGO-02-028	Support to design and test of cooling technologies		350.000	
JTI-CS-2010-3-SGO-02-029	Tests of advanced lubrication equipment		350.000	
JTI-CS-SGO-03	*Area-03 - Management of Trajectory and Mission*		**750.000**	
JTI-CS-2010-3-SGO-03-008	Modeling of weather phenomena to support Advanced Weather Radar development		750.000	
JTI-CS-SGO-04	*Area-04 - Aircraft Demonstrators*		**2.000.000**	
JTI-CS-2010-3-SGO-04-001	Design and manufacture of an aircraft tractor compliant with specifications for Smart Operations on ground		2.000.000	
JTI-CS-SGO-05	*Area-05 - Aircraft-level assessment and exploitation*		**0**	

Clean Sky Joint Undertaking
JTI-CS-2010-3-SGO-02-019

Topic description

CfP Nbr	Title		
JTI-CS-2010-3-SGO-02-019	**Sample PEM (Power Electronic Module) construction for testing, characterisation and manufacturability assessment**	End date Start date	September 2013 November 2011

1. Background

This activity within WP2.3.0 of SGO is concerned with 1) fully-characterised power module samples and 2) the provision of reliability models and methods in support of the virtual prototyping of integrated power technologies. The work package consortium will develop a virtual prototyping solution tailored at the needs of integrated power electronics assembly development, which fills the gap between discipline-specialized software, on the one hand, and generic purpose circuit simulators on the other. It will deliver computationally efficient methods and demonstrate their applicability to design optimization and manufacturability assessment. In particular the activity will be tailored at the development of an all SiC 10kW inverter, implemented in a double-side cooled, non-hermetic *sandwich* packaging technology (no bondwires), able to withstand a nominal ambient temperature range of -60°C to +200°C. The gained know-how will be implemented in the form of a tool, which will provide designers and manufacturers of integrated power assemblies not only with insightful characterization capability, but also, and above all, with the ability for versatile re-design, optimization and validation against a given set of realistic design constraints.

A key part of the work involves the validation of the electrical, thermal and reliability models that underpin the virtual prototyping tool. The consortium is now seeking a partner who can contribute to both the development of reliability models and the validation of the developed models for two distinct module types, as detailed below.

2. Scope of work

The partner will contribute in two key areas:

1) The provision of fully characterised module samples in two formats hereafter referred to as type 1 and type 2. Characterisation will include electrical, thermal and reliability testing as detailed below. Module type 1 is a conventional power module, of an agreed specification, based on a DBC (Direct Bond Copper) or AMB (Active Metal Bonding) substrate onto which are bonded a plurality of SiC dies. The die interconnect will be via heavy gauge Aluminium wires. The substrate will be solder bonded to a base-plate manufactured from copper or a metal-matrix composite. Copper bus-bars will be bonded to the substrate and will provide the module level interconnect. The module will have a suitably encapsulated plastic case and will be non-hermetic. Module type 2 is a planar or sandwich module. This module is the subject of another activity in SGO and so a specification of the manufacturing process is not yet available, although it will be based on a non-hermetic sandwich technology. It is anticipated that a combination of expertise and capability in rapid prototyping, electroforming, diffusion soldering and/or sintering and encapsulation processes will be needed to realise the type 2 module samples.

2) The provision of validated physical wear-out models for modules type 1 and type 2. Work will commence with a FMMEA (Failure Modes, Mechanisms, and Effects Analysis) study of module types 1 and 2 to identify the principal wear out mechanisms and impact on performance. This will be followed by development of initial physical models for a selected set of wear-out mechanisms, which will then be submitted for evaluation and integration into the virtual prototyping tool. The work will conclude with validation of the wear-out models within the virtual prototyping tool against reliability test data. A probabilistic approach which estimates the spread in life consumption as well as the expected mean value will be required.

Specific details of the anticipated work packages are given below.

3. Type of work

The detailed programme of work and associated deliverables (D1 to D9) are to be broken down into 5 interrelated work packages as follows:

WP1 FMMEA analysis (D1): A comprehensive failure modes, mechanisms and effects analysis will be carried out for module types 1 and 2. The principal wear-out mechanisms will be identified and a literature review carried out to establish the current state-of-the-art.

WP2 Physical wear-out model development and integration (D2): Initial physics of failure models will be built based on available experimental data, finite element models and other appropriate analytical techniques. The models will take continuous temperature-time data (as a spatial distribution or as point values) as an input and will deliver life consumption estimates (mean value and statistical spread) for each of the selected wear-out mechanisms. An approach based on either constitutive or cyclic wear-out models may be adopted provided it provides accurate predictions of wear-out for each selected mechanism over the operating temperature range.

WP3 Optimisation framework and model integration (D7): A functional simulation framework for automated design/layout/assembly optimisation on the basis of user specified target parameters (e.g., maximum temperature) will be developed. The physical wear-out models from D2 will be integrated with the electro-thermal and electromagnetic models being developed by the consortium and incorporated into the optimisation framework.

WP4 Module samples for evaluation (D3, D5): Type 1 and type 2 modules will be built to an agreed specification in sufficient quantities to allow statistically representative electrical, thermal and reliability data to be acquired. Component parts of the modules may be used as test coupons where appropriate and agreed within the consortium.

WP5 Electrical, thermal and reliability evaluation (D4, D6, D8): Electrical testing will comprise measurement of static and switching performance (full range of parameters to be agreed) over the full operating temperature range for both types of module. Thermal testing will comprise the determination of the steady state and transient (step response) thermal impedance from each active die to the ambient cooling medium. Reliability evaluation will comprise power and passive thermal cycling tests over a range of agreed temperature profiles. Samples will be monitored continuously (power cycling) and/or removed for microstructural evaluation at specified points during testing (Note that the partner is NOT required to undertake any microstructural evaluation as this will be performed by other consortium members). Population statistics will be required for all measured variables (a minimum of mean, standard deviation and skew).

WP6 Virtual tool validation (D9): The experimental electrical, thermal and reliability characteristics of both types of module will be used to validate the electrical, thermal and reliability models within the virtual prototype tool. Note that the partner will be responsible for validating only the reliability models as part of this task; validation of the electrical and thermal models will be the responsibility of other consortium members.

4. Special skills, certification or equipment expected from the applicant

The successful partner will:

1) Include a power module manufacturer equipped and resourced to deliver module types 1 and 2 as detailed above. In particular, the module manufacturer must be able to demonstrate access to expertise and capability in rapid prototyping, electroforming, diffusion soldering and/or sintering and encapsulation processes as appropriate to the fabrication of module type 2.

2) Have experience of the development, calibration and validation of load cycle-counting algorithms, physical wear-out (physics-of-failure) models, optimization methodologies for power modules and the integration of those models and methods with virtual prototyping tools.

3) Have access to appropriate electrical, thermal and reliability evaluation facilities.

4) Be able to demonstrate an established track record in working with industry and academia in recent multi-partner projects on power module technologies for aerospace applications.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	FMMEA delivered	FMMEA available for module types 1 and 2	December 2011
D2	Physics of failure models delivered for review and integration	Initial physics of failure models available for module types 1 and 2.	December 2011
D3	Module type 1 test coupons delivered	Module assemblies delivered for electrical characterisation, thermal characterisation, power cycling and passive cycling studies	December 2011
D4	Module type 1 electrical and thermal test results		January 2012
D5	Module type 2 test coupons delivered	Module assemblies delivered for electrical characterisation, thermal characterisation, power cycling and passive cycling studies	September 2012
D6	Module type 2 electrical and thermal test results delivered		December 2012
D7	Optimisation framework and physics of failure models integrated into virtual tool		December 2012
D8	Reliability test results available	Power cycling and passive cycling results available for both module types	June 2013
D9	Validation results for the virtual tool available for electrical, thermal and reliability performance of modules type 1 and 2		September 2013

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 500.000,--
[five hundred thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

Topic description

CfP Nbr	Title		
JTI-CS-2010-3-SGO-02-020	**Development of key technology components for high performance electric motors**	End date	March 2013
		Start date	April 2011

1. Background

Moving from traditional hydraulically actuated rotorcraft control surfaces to more electrical based systems has many potential advantages. Lower maintenance costs, improved flight dynamics and system reliability as well as a reduction in weight at rotorcraft level can all be achieved with this approach improving the overall environmental impact of rotorcraft operations. The main challenges with adopting hydraulic-free electromechanical actuators relate to power density and actuator jamming. This call for proposal (CfP) deals with the development and manufacturing of high performance electrical machines able to actuate the swashplate of the main rotor of a medium-sized rotorcraft. The electrical machines will be an integral part of a novel jam-free, fault tolerant electromechanical actuation system designed by the SGO WP2.3.4.2 project team. The selected partner will work closely with the SGO WP2.3.4.2 team to develop, manufacture and test a set of electrical machines and associated sensors. In an effort to maximise the performance to weight ratio the machines are likely to require high specification soft and hard magnetic materials, high slot fill factor together with a high temperature and high thermal conductivity impregnating resin.

2. Scope of work

The aim of this CfP is to find a partner who has the necessary experience and capabilities to develop and manufacture high performance electrical machines. The partner will be required to provide input in the design of the machines being undertaken by the SGO WP2.3.4.2 team. The selected partner will then deliver in the first instance 2 prototype motors manufactured to different designs for initial investigations, followed by a set of 12 simplex electrical motors or a fewer number of fault tolerant machines able to produce intermittent power up to approximately 4Nm at 8000rpm together with high precision integrated resolver/s. A key requirement is the partner's flexibility in manufacturing novel designs of electrical machines with high specification magnetic and insulating materials, to include flux-switching (permanent magnets embedded in stator part of the rotor) or embedded permanent magnet machines, possibly with Halbach arrays.

The partner to be selected will be responsible for :

- Technical design input
- Materials selection
- Manufacturing
- Component Testing
- Delivery of initial hardware prototypes (2)
- Delivery of hardware sets (potentially 12 or less)
- Support during system verification tests.

3. Type of work

Applicants should identify the key skills and capabilities in developing and manufacturing of high performance electrical machines to new design concepts and demonstrate their track record in manufacturing such machines.

4. Special skills, certification or equipment expected from the applicant

The successful partner will have:

1. A track record in manufacturing high performance electrical machines.
2. Experience in working with high specification magnetic materials.
3. Experience in manufacturing rotor assemblies including laminated magnets and Halbach arrays.
4. Flexibility in manufacturing alternative motor topologies based on fault-tolerant design concepts.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Motor+Sensor Preliminary Design Review		September 2011
D2	Delivery of 2 prototype machines for test and evaluation		January 2012
D3	Motor+Sensor Critical Design Review		July 2012
D4	Delivery of remaining Motor Units (12 units)		February 2013

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 250.000,--
two hundred fifty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

Topic description

CfP Nbr	Title		
JTI-CS-2010-3-SGO-02-021	**Development of key technology components for high power-density power converters for rotorcraft swashplate actuators**	End date Start date	March 2013 April 2011

1. Background

This work package (WP2.3.4.2) within the JTI "Clean Sky" SGO aims to develop electro-mechanical actuation systems for rotor aircraft control surfaces. The potential benefits of moving away from an all hydraulically actuated rotorcraft are lower system weight, increased reliability and lower maintenance costs. This call for proposal (CfP) deals with the development and manufacturing of high performance power electronic converters, able to drive the associated electrical machines; that in turn, actuate the main rotor of a medium-sized rotorcraft. The power converters will form an integral part of the fault tolerant actuation system designed by the HEMAS (Helicopter Electro-Mechanical Actuation Systems) project team. The selected partner will work closely with the HEMAS team to develop at the component level, manufacture and test a set of power converters. Reliability/availability and weight are key to this project. The unit will be expected to operate with no forced cooling in an ambient temperature of 70C. Development of a suitable power module is therefore a major part of this call. These power modules will be designed to withstand a high degree of thermal cycling using the minimum weight possible. The integration of sensors and/or the use of diagnostic techniques to enable the detection of failures within the power circuit is also necessary.

2. Scope of work

The partner will contribute in the following ways:

1) Provide technical input to the HEMAS team during the power converter design process.

2) Develop suitable power modules to fulfil the reliability and weight requirements

3) Develop / demonstrate suitable sensor technologies to enable the rapid detection of faults within the circuit.

4) Construct single motor output drive power converters (14) or several multi-output drive converters for use in the HEMAS demonstration system

5) The final design may be integrated into the motor-actuator structure so close co-operation with the HEMAS team will be necessary throughout the process. Suitable heat-sinking / cooling arrangements will need to be identified, designed and manufactured by the partner.

The partner will also be responsible for:

- Manufacturing
- Component Testing
- Support during system verification tests.

3. Type of work

Applicants should identify the key skills and capabilities in developing and manufacturing of novel high performance power electronic converter components and demonstrate their track record in manufacturing such converters.

Key aspects for the design of the power modules are reliability, high temperature operation, weight. The modules should be designed for minimum electrical losses, potentially using novel semiconductor technologies, maximum thermal conductivity through to the ambient air and with a high degree of tolerance to thermal cycling related failures.

Robust sensor / detection techniques should be developed or demonstrated so that faulty components can be taken out of use as quickly as possible to enable the continued operation of the rest of the system.

The partner will be expected to manufacture and test the final power converters with a high degree of quality in sufficient quantities to allow the system to be fully demonstrated. A minimum of 14 single motor output or 7 dual output converters will be required (plus spares)(< 8kW each aprox). Fault tolerant features and sensor arrangements will be required to be tested and demonstrated. If the failure mode testing/demonstration of these features require over-stress or destruction of the components then sufficient extra converters will need to be constructed to enable the testing. The final converters should also be designed and constructed such that any failure cannot cause or propagate any other failures within the system. This can be achieved either at the individual component level or power converter level.

Suitable heat transfer / heat-sinking technologies should be used / developed so as to minimise weight whilst maximising reliability. Natural cooling / ventilation will be used for the design. The heat sinks will need to be manufactured or sourced by the partner to enable potential integration with the final actuator structure.

4. Special skills, certification or equipment expected from the applicant

The successful partner will have:

1. A track record in manufacturing high performance electrical power converters.
2. Experience in design and manufacture of power modules for high reliability applications including design for failure propagation mitigation.
3. Flexible manufacturing facilities to enable alternative power converter topologies and design concepts to be used in the project.
4. Experience in the drive, control and monitoring of IGBT and/or related switching devices.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Preliminary design review of: power module packaging solution, Sensor / failure detection techniques and Heat removal solutions.		September 2011
D2	Production of 2 prototype power modules together with sensor/failure detection techniques for experimental evaluation.		January 2012
D3	Critical design review of whole power converter design.		March 2012
D4	Delivery of 2 prototype power converters for test and evaluation		July 2012
D5	Delivery of remaining Power Converter Units.		February 2013

6. Topic value (€)

The total value of biddings for this work package shall not exceed : **€ 250.000,--** **two hundred fifty thousand euro]** Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

Topic description

CfP Nbr	Title		
JTI-CS-2010-2-SGO-02-022	**Fan noise reduction: study and realization of a sub-assembly dedicated to new generation of Starter/Generator for Regional Aircraft and BizJet**	**End date**	02.09.2012
		Start date	01.10.2010

1. Background

The decreasing of aerodynamic component of noise becomes an important issue in electric machine design. The fan noise which is the main source of aerodynamic noise in air-cooled electric machines takes its origin in the fluid /structure interaction generated by the rotating blades feeding the ventilation duct. Particularly the pressure and speed fluctuations are produced and also seen by the blades.

The progress in understanding of aerodynamic noise can be achieved by studied of the turbulent airflow in the rotation machine with its duct system. This approach must be able to capture the effects impacting the fan performance and subtract the elements to provide the greatest possible reduction of noise

2. Scope of work

The goal of the work is the optimization of the fan and duct geometries in electrical machine in order to improve both the hydrodynamic (the maximal flow volume drawn by the fan) and acoustical performance.

For this purpose, a design methodology will be developed and the associated numerical model allowing the simulation of the airflow of the hole cooling chain of the electrical machine will be delivered. The air rotation inside the electrical machine will be taking into account for the flow field study, also as the temperature conditions and speed variation of the flow.

A correlation work will be performed to validate the methodology and associated model regarding the existing test results like nose and air flow measured results. The predicted computational results as air flow rate and noise must meet the specific requirements for this kind of electrical equipment.

The parameter model provided by partner will be able to make the choice of the better design of the fan and air duct system regarding above requirements. The design strategy must be justified and meet the requirements of aeronautic common design practice.

The set up of the complete optimization loop will be done: capture of all majors parameters that are responsible of the final design, for different varied given parameters (rotation speed, temperature).

Also the whole development strategy shall be justified and documented.

3. Type of work

To perform a joint activity with our team, to define the level and required predictive capability of the model. To issue of a report with the first model definition including the design strategy.

The flow field simulation and noise prediction of electric machine with respect to specific requirements. The report with model description, detailed analysis and justified retained solution. Delivery of the numerical model (ANSYS CFX).

The report with the optimisation problem solution: identification of the major influent parameters for the final design. The final design proposal that fulfil the specification requirements.

4. Special skills, certification or equipment expected from the applicant

Experience in simulation and design of air-cooled systems.

Experience in acoustics simulations and design.

A recognized experience in flow field configuration modelling using CFD (Computational Fluid Dynamics) software as ANSYS CFX; though, the list of publications is suitable.

Knowledge in aeronautic field constraints and procedures

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Report with the methodology description. Delivery of the design strategy.	Definition of the level and required predictive capability of the model	Jan 2011
D2	Report with a detail analysis of the flow field simulation and noise prediction. Delivery of a design analysis and improvement recommendation with associated model		Jan 2012
D3	Report with the final design proposal. Implementation of the improvement recommendation with a new design of the fan and duct		Sept 2012

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 200.000,--
two hundred thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

Only if applicable.

Topic description

CfP Nbr	Title		
JTI-CS-2010-3-SGO-02-023	Development of current and voltage sensors suitable for aircraft environment	End date	01.09.2012
		Start date	01.10.2010

1. Background

The purpose of this call for proposal (CfP) is a design of current and voltage isolated sensors withstanding harsh environmental avionics constraints. These features shall be designed in order to contribute to the extended study of high integrated electronic converters dedicated for more electrical aircraft in the frame of Cleansky project

2. Scope of work

AC, DC Current and DC voltage sensor types must be based on the same principle of technology and to insure voltage sensor function, an additional circuit should be used.
Environmental and operating requirements to be complied by these sensors will be detailed in dedicated technical specification.

Main requirements are:

a) Harsh Environment condition with:
- Thermal operating ranged between –55°C and +105°C mini
- Storage condition ranged between –65°C and 85°C
- Temperature variation defined in DO-160 section 5,
- Overpressure and altitude defined in DO-160 section 4,
- Humidity defined in DO-160 section 6,
- Cycling profile mission will be defined in the detailed technical specification,
- Fluids susceptibility defined in DO-160 section 11.

b) Electrical and physical performances:
- Primary nominal R.M.S I_{PN}=400 A
- Primary R.M.S current ranged from 0 to ±500 Amps.
- High measurement accuracy,
- Response time for measurement to be defined in technical specification,
- Very low temperature drift and excellent linearity (linearity error <0.2%)
- Wide bandwidth frequency with minimum of 100kHz,
- Max Dimension (longueur: 34 mm, largeur 30 mm, hauteur 12mm)
- Weight shall be optimized
- Other shape with respect total volume acceptable.
- High immunity to external electromagnetic interference specified in avionic standard (see RTCA DO-160E standard),
- Galvanic insulation between primary and secondary circuit
- Current overload capability
- Extended life duration to airplane life (100 000 operating hours)
- Very low current consumption (less than 1 milli-ampere)

Sensors shall be fitted and designed with structural material in conformity with commercial airplane requirements in term of self-extinguishment and others specification to be defined in the technical specification.
AC, DC Current and DC voltage sensor types must be based on the same principle of technology of magnetic core. To ensure voltage sensor function, an additional circuit should be used.

Environmental and operating requirements to be complied by these sensors will be detailed in dedicated technical specification.

3. Type of work

1.1 Design cycle planning
The activities of this work shall be limited to 24 months time period.
A kick-off meeting, a progress meeting and final meeting will be scheduled with topic manager. This project is split into following tasks proposed for the applicant activities:

At T0 (assumed 01.10.2010):
Kick of meeting to start project.
Review of technical specification and planning to be frozen.
Task 1: (T0+2M)
Clause by clause and final specification version.
Task 2: (T0+8M)
Preliminary design review of technical proposal in accordance with specification control drawing . At this step, the technology of current and voltage sensors shall be frozen.
Task 3: (T0+12M)
Final Design Review of technical proposal for current and voltage sensors.
Task 4: (T0+15M)
Set of current and voltage sensors samples manufactured for evaluation and validation.
Minimum of 10 units per sensor type shall be evaluated.
Test procedure of samples for validation.
Task 5: (T0+18M)
Test report of validated samples and validation ok.
Task 6 : (T0+24M)
Fives samples of each sensor type (current and voltage) and justification documents will be delivered to close the project.
Progress reports will be requested every two months

4. Special skills, certification or equipment expected from the applicant

For this study, the applicant shall satisfy following criteria:

- Good background and experience in sensors activities,
- Applicant shall masteries perfectly existent current and voltage sensors technologies like hall effect, open and close loop, fluxgate, …
- Innovative material and advanced sensors technologies are accepted if minimum of maturity is demonstrated in equivalent harsh environment.
- Insurance shall be provided to manage this work in time without delay for study and development phases.
- Adequate equipment with tools, manufacturing process and test benches to develop and test requested sensors in respect with milestone of delivery,
- Available resources to execute the respective tasks should be stated in the proposal.

5. Major deliverables and schedule

Deliverable	Title	Due date
D1	Compliance Matrix with final technical specification	Jan 2011
D2	Final drawing /justification document/material list	Sept 2011
D3	Delivery of five final specimen (minimum) of each sensor type (with datasheet) for evaluation on converter application by customer	Sept 2012

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 600.000,--
[six hundred thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

What level of innovation is requested? Environmental conditions: what is different as compared to nowadays conditions?
Electrical and physical performance: in which field is the big step/progress? Aspects of predictability, price (many sensors needed in the more electric aircraft!?); same types/accuracies needed at all positions?

Answer:

The purpose of this CfP is mainly focused on new material and devices to be used in order to withstand the aeronautic environmental constrains in pressurized and none pressurized zone.
For information, the existing current and voltage sensors have been designed for industrial application but are not fully complying with avionic standards, especially below – 40°C.

The first criteria of the current and voltage sensors to be developed in the frame of this CfP will be the capability to operate with good accuracy and reliability when submitted to harsh avionic constrains of low temperature (up to –60°C - Refer to aeronautic standard RTCA-D0-160), high amplitude variation of operating temperature (-60 to +125°C or more), depression, humidity, vibration and EMI/EMC constrains.

The second criteria will be the compliance with THALES request in term of physical (low weight and volume) and electrical performances. Weight and volume will become key requirements since these sensors will be used in quantity in the future more electrical aircraft.

Cost will be also a key driver of these components.

Topic description

CfP Nbr	Title		
JTI-CS-2010-2-SGO-02-024	**Test bench for endurance test and reliability prediction of avionics power electronic modules**	End date	01.09.2012
		Start date	01.10.2010

1. Background

The purpose of this call for proposal (CfP) is to design a specific test bench dedicated to electrical characterization, highly accelerated combined tests and electrical expertise of critical devices and sub-assemblies used in power electronic converters needed for more electrical aircraft in the frame of Cleansky project.

The interest and the need of this specific test bench is to give more confidence of the design in term of reliability at components level and help the user to expertise and to validate the minimum life expectation of future aircraft power electronics converters.

Today, reliability and life expectation of electronic converter are studied at components level by using military standards books like MIL-HDBK or estimate calculation based on background of components class used in similar application. These methods provide rough estimation and needs to be compared to realistic endurance tests. This test bench will allow achieving this objective

2. Scope of work

Key components to be characterized are power transistors (MOSFET, IGBT), power rectifier diodes and capacitors.
The applicant shall be able to define a specific multi-components bench test based on these components.

Following main functions and features shall be considered :

1) **Climatic chamber associated with vibration test system** in order to combine thermal and mechanical constraints specified in avionic standards.
   1.a) **The climatic chamber will have following main characteristics**:
   - Temperature variation ranged between -65°C and +180°C,
   - Temperature change rate ranged between 5°C per minute to 70°C per minute,
   - Thermal regulation accuracy with ±1°C,
   - Hold temperature until –55°C with 5kW heat dissipation,
   - Hygrometry mode capable of simulating conditions from 10 to 98% RH.
   - Minimum test space needed: width: 750mm /Depth:750mm/ Height: 750mm,

   1.b) **Vibration test system with performance according RTCA DO-160** section 8 requirements (detail will be defined in technical specification)
   - Diameter of vibrator: 710mm
2) **Electrical characterization bench test** of keys parameters (to be defined in specification document),

3) **Graphical user interface for powerful supervisor to control and monitors climatic and vibration parameters** (defining endurance test cycling, recording data…)

The applicant shall perform following main activities:

- Define adequate multi-components test bench with the costumer (user),
- Design, manufacture and validate the test bench,
- Install the test bench at customer facilities,
- Validate the test bench at customer facilities,
- Training phase of technical user,

2. Type of work

Planning and deliveries

The activities of this study and development shall be limited to 24 months time period.

A kick-off meeting, a progress meeting and final meeting will be scheduled with topic manager site. This project is split into following tasks proposed for the applicant activities:

At **T0 (assumed 01.10.2010):**

Kick of meeting: review of generic specification and planning.

Task 1: (T0+4M)

Review of final detailed specification.

Task 2: (T0+10M)

Design Review of the test bench.

Task 3: (T0+14M)

Manufacture of the test bench.

Task 4: (T0+20M)

Installation of test bench in the facilities of SGO member. Acceptance test report to validate the bench.

Technical training phase from applicant to SGO member in order SGO member can operate the test bench autonomously.

Task 5 : (T0+24M)

Final meeting to close this project.

Progress report will be requested every two months

Documentation for installation and maintenance shall be delivered by the applicant.

4. Special skills, certification or equipment expected from the applicant

For this study, the applicant shall satisfy following criteria:

- Strong experience in the field of industrial test bench design and manufacturing is mandatory,
- ISO qualification for the design and manufacturing of industrial test benches is mandatory,
- Experience and knowledge of electronic components test bench is a key factor,
- Knowledge of RTCA-DO-160 standard and aeronautic environmental requirements is an advantage,
- Innovative material and advanced sensors technologies are accepted if minimum of maturity is demonstrated in equivalent test bench and if development risks are limited.

- Insurance shall be provided to manage this work in time without delay for study and development phases.
- Available resources to execute the respective tasks should be stated in the proposal.

5. Major deliverables and schedule

Deliverable	Title		Due date
D1	- Compliance Matrix with final technical specification. - Development plan.		Jan 2011
D2	- Design description and datasheet of test bench. - Preliminary Drawing		Jul 2011
D3	- Manufacturing test bench (possibility for the applicant to install it directly at customer facilities or to manufacture bench in his proper facilities and validate functions before to deliver it to the costumer)		Nov 2011
D4	- Validation test report, - Delivery to costumer facilities, - Installation and Acceptance test report of test bench		May 2012
D5	- Drawing (test bench plan) and maintenance manual.		Sept 2012

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 800.000,--

[eight hundred thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

Question:
Is it possible to indicate relation with existing test rigs?
Answer:
Today, two main types of test rigs exists:

1) Fist type of test rig is mainly used for qualification of components and/or electronic converters with using power cycling, VRT test benches or specific but standard test benches to comply with dedicated mechanical (vibration, acceleration) only or Climatic requirements according to aeronautic standards.
2) Second type of test rig is mainly used for robustness of component or equipment with applying HALT/HASS tests methods.
   These specific tests benches combine the temperature variation and vibration constrains to estimate operating margin of component or equipment.

Within this CfP, its requested to add a new step and to analyze, develop, and implement new protocol of tests which allow combination of several parameters, for reproducing more realistic avionic environmental constrains on these critical components (IGBTs, MOSFETs, Diodes, current and voltage sensors, …)

The needed test rig shall combine following parameters such as:

- Low, high and temperature variation,
- Humidity,
- Pressure (over and under pressure)
- Vibration
- Electrical

The re-configurable MMI interface will be requested in order to specify adequate mission profile, and relevant level for each parameter…

Taking into account the huge quantity of these critical components in the aircrafts to come, the availability of such a tool along with the relevant expertise is mandatory.

Clean Sky Joint Undertaking
JTI-CS-2010-3-SGO-02-025

Topic description

CfP Nbr	Title		
JTI-CS-2010-3-SGO-02-025	**Definition and realisation of a field bus suitable for a multi-PEM (Power Electronic Module)**	End date	01.09.2012
		Start date	01.10.2010

1. Background

The “More Electric Aircraft” is definitely the way to go as a better control of the Energy flow and therefore a better Specific Fuel Consumption can be expected. It will then provide a more precise & intelligent Power System Control

2. Scope of work

The current “Power Control” solutions do not show the necessary power density required by a “More Electric Aircraft”. Therefore, an innovative “Power Controller or Manager” will be designed. Such a “Power Manager” shall be made of several Power Electronic Modules (PEM) that shall be controlled, coordinated and safely managed. Moreover, as the “Power Manager” function is meant to drive multiple loads, it is necessary to design a robust, reliable and scalable architecture. The foreseen architecture is made of two major layers at least. The first layer is the “Power Electronic” layer exclusively made of PEMs that shall be designed to provide the necessary current to the loads. The second layer is in charge of controlling of the PEM resources and making sure that they share the necessary data to provide the necessary function when required. Consequently, the second layer shall incorporate two buses serving the following two different purposes:

- Ensure safe communication with the “Supervision”
- Ensure safe communication between all PEMs

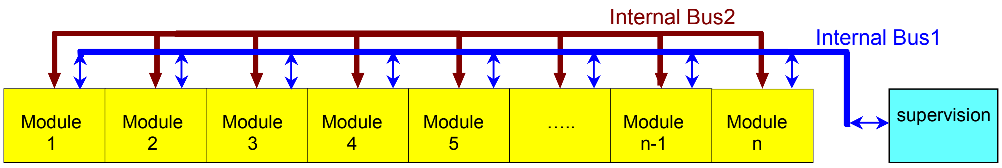
The performance of the buses will determine the performance of the overall “Power Manager” function.

A first project shall demonstrate the feasibility of a such architecture. In this project, the buses have been chosen without taking into account any aeronautical constraints. It is essential to find aeronautical quality level buses otherwise this architecture will have no future. This is the aim of this topic. The applicant shall search and define buses to comply with aeronautical environment and requirements. At the end of this study, the TRL (Technology Readiness Level) to reach for the buses is 5-6.

3. Type of work

Architecture description:

These buses have to allow the connection in multidrop of the functions "supervision" to “modules” and modules to modules



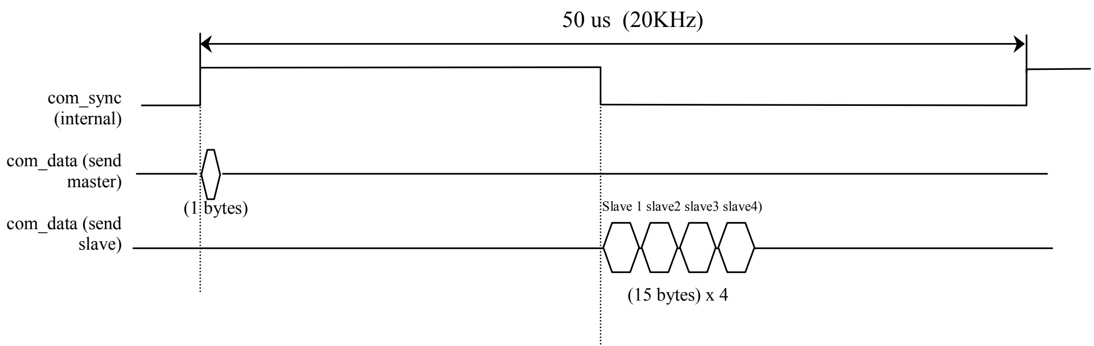
internal bus 1 description:

Baud rate	:	xx Mbps TBD
Useful rate	:	< 500kbps
Node number	:	9
Determinism	:	TBD
Frame periodicity	:	1Hz à 500Hz, or on event
Data type	:	Setpoint, control, measurements, 0/1, diag, debug
Redundancy	:	yes
Length	:	< 5m (TBC)
Galvanic insulation	:	no
Admissible latency	:	< 1ms

internal bus 2 description :

Baud rate	:	xx Mbps TBD
Useful rate	:	< 10 Mbps
Node number	:	10
Determinism	:	yes
Frame periodicity	:	20kHz
Data type	:	For control purposes
Redundancy	:	TBD
Length	:	< 3m (TBC)
Galvanic insulation	:	no
Admissible latency	:	< 10us

For application where several modules are used in parallel to increase the power delivered to the load, one module is designated as a master, and the other modules as slaves. This designation is performed by the Supervision during the system configuration phase.
During load control phase, the master and the slaves shall communicate through internal bus2. Some data shall be dated. The date tolerance shall be +/-100ns. The date information can be sent through the internal bus, but it seems to be easier to use an synchronization clock signal for this purpose. The following chronograph shows such application:



At the falling edge of the synchronization clock, called com_sync, the slaves store in memory the data which must be dated. Slave number 1 sent its stored data, then slave2 and so on up to the number of slaves for the application. So when the master receives the data from all the slaves, it knows exactly the date of the data. At the rising edge of the clock, the master stores in memory the data which must be dated for the slaves and then transmits these data to the slaves.

It shall be one of the missions of the applicant to define if both buses characterized above can be integrated into the same bus of communication or if it will be necessary to live in architecture with two different buses.

Certain transmitted data are dated and the precision on the required dating is +/-100ns. There is possibility of using a clock signal to do it, but we would be interested to suppress this signal of clock if it was possible.

Core properties for the data busses

The bus(ses) shall allow very fast and simple system integration. Strong partitioning should be possible to reduce complexity and better prevent fault propagation thus simplifying system certification. Determinism should allow simpler verifiability and testability.

The bus(ses) shall allow a scalable architecture. Modularity should be given as well as reusability.

The bus controller(s) shall be included in an ASIC (Application-Specific Integrated Circuit) or FPGA (Field-Programmable Gate Array ,preferred) and no CPU and/or software shall be needed to service the bus controller. No gateway to other data bus is needed, both busses remain internal to the system.

Tooling shall be provided to be able to generate the configuration for the bus controllers at design time.

The proposed bus(ses) shall be robust under very noisy environments. A robust physical layer shall be part of the proposal.

The loss of several nodes shall not cause the loss of the complete network.

4. Special skills, certification or equipment expected from the applicant

The applicant should have a strong background in the design of safety critical architectures.

The applicant should have experience with
- the development of deterministic high speed data busses.
- the development of busses suited for tightly coupled distributed controls with minimal latency and jitter
- the development of robust bus and physical layer for noisy environment
- DO-254 and DO-160 certification as aeronautical quality level is required
- the development of configuration tools for data bus controllers
- the development of monitoring hardware and tools for data busses

5. Major deliverables and schedule

Deliverable	Title	Due date
D1	Assessment of the feasibility	March 2011
D2	Requirements document for data bus and physical layer	Sept 2011
D3	Demonstration : 5 modules (deliverable) and delivering of a bus monitoring solution with HMI (Human Machine Interface) PC	Sept 2012

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 500.000,--
[five hundred thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

Only if applicable.

Clean Sky Joint Undertaking
JTI-CS-2010-3-SGO-02-026

Topic description

CfP Nbr	Title		
JTI-CS-2010-2-SGO-02-026	**Modelica Model Library Development**	End date	30.11.2012
		Start date	01.12.2010

1. Background

The Systems for Green Operations ITD of Clean Sky aims to demonstrate substantial environmental and economic benefits of more electric aircraft systems technologies. The design and validation of such highly integrated systems urge the need for more co-operative development processes involving aircraft, engine, and equipment manufacturers. The design process has to be supported through advanced modelling and simulation capabilities. Therefore the goal of the consortium is to define standardised modelling methods and tools in each phase of the energy system design process.

The Systems for Green Operations ITD is looking for several Modelica modelling specialists to become a partner of the consortium for implementation of the following Modelica libraries and models:

1. Modelica media models for often used media in aircrafts.

2. Modelica library for detailed converters, electrical machines and basic magnetic models as needed for aircraft electrical systems.

3. Modelica library for wavelets to improve power quality assessment in aircraft electrical systems.

2. Scope of work

<u>1. Modelica media models for often used media in aircrafts</u>

In Clean Sky SGO ITD, several members are working on modelling and simulation of thermal aircraft systems (such as environmental control systems, supplemental cooling systems, thermal management). These efforts rely on accurate representations of the thermodynamic properties of the involved fluids.

This call for proposal covers the implementation of thermodynamic property models for the refrigerant R134a and moist air. Both shall be implemented in the modelling language Modelica following the interface of the standard library Modelica.Media.

The refrigerant R134a shall be implemented according to Tillner-Roth and Baehr [1]. The implementation shall cover all elements defined in the interface Modelica.Media.Interfaces.PartialTwoPhaseMedium (and its super classes) and have the range of validity of the original reference.

A moist air model is already included in the Modelica Standard Library (Modelica.Media.Air.MoistAir). However, the range of operating conditions for the applications in aerospace is beyond the validity of this implementation. Therefore, the available implementation shall be expanded with respect to the temperature range of validity to -100°C to 250°C. Furthermore, all elements defined in the utilized interfaces but not in the implementation shall be added (such as the function isentropicEnthalpy()).

Both implementations have to be released for inclusion in the Modelica Standard Library under the Modelica License 2.0 (see http://www.modelica.org/licenses/ModelicaLicense2).

This is related to work contracted in the 2nd call (JTI-CS-2009-2-ECO-02-002) and shall be coordinated with the latter.

<u>2. Modelica Library for Converters, Electrical Machines and Basic Magnetic Models</u>

In more electric aircraft the Modelica.Magnetic library is of great interest for converters (e.g. transformers) and electrical machines (e.g. synchronous machine). The following components shall be developed, extending the Modelica.Magnetics library:

- General Hysteresis model for integration into FixedShape models leading to stable simulation even for complex models.

- Modelica functions to fit material data/measurements to hysteresis models.
- Modelica functions to fit material data/measurements to current magnetisation characteristic functions.
  (i.e. relative permeability as a function of magnetic flux density).
- Hysteresis characteristics for common soft materials.
- A library for standard transformers containing:
  - General 1-phase and 3-phase transformer models (customizable).
  - Models for delta-delta, wye-wye, delta-wye and wye-delta 3 phase transformers.
  - Nonlinear material characteristics and hysteresis properties that are tuneable.
  - Internal model properties like electrical resistance of windings, magnetic reluctances and further shall be calculated within the transformer-models derived from basic geometric properties of the transformer (dimensions, number of turns, …).
  - Optional eddy current elements shall be integrated into the models (either provide extra models considering eddy current losses or conditional eddy current element).
  - The heat dissipated due to resistive, eddy current and hysteresis losses shall be provided via optional heat ports.
- Nonlinear demagnetisation curve for hard magnetic materials.
- Permanent magnet element.
- Lamination of material shall be considered in fixed shape elements and transformers (via stacking factor).
- Rotational elements containing:
  - Torque elements equal to force elements (air gap)
  - Basic electrical machines (e.g. synchronous machine) using:
    - magnetic library elements or
    - look-up tables

The developed models (especially the transformers) shall be validated against real measurements.

All improvements and extensions shall be documented for user friendly and intuitive utilization.

All implementations have to be released for inclusion in the Modelica Standard Library under the Modelica License 2.0 (see http://www.modelica.org/licenses/ModelicaLicense2).

3. Modelica Library for Wavelets:

The wavelet method offers significant features in capturing, identifying, and analyzing local, multiscale, and nonstationary processes. To exploit the powerful functionalities from wavelet methods such as analyzing, reconstructing, and modelling signals, a Modelica wavelet library is to be developed. The desired wavelet library shall contain the following key features:

- Standard wavelet families, including Daubechies wavelet filters, complex Morlet and Gaussian, real reverse biorthogonal, and discrete Meyer.
- Wavelet and signal processing utilities: analysis and synthesis.
- Interactive tools for continuous and discrete wavelet analysis.
- Customizable presentation and visualization of data.
- Wavelet packets.

The library should be implemented with reliable and efficient numerical algorithms.

The developed library has to be released for inclusion in the Modelica Standard Library under the Modelica License 2.0 (see http://www.modelica.org/licenses/ModelicaLicense2).

3. Type of work

1. Modelica media models for often used media in aircrafts

The selected partner has to lead the implementation, documentation and validation of the thermodynamic property models of the given fluids.

2. Modelica Library for Converters, Electrical Machines and Basic Magnetic Models

The task of the new partner is to design and implement a Modelica.Magnetic Library Extensions and validate the models against measurements.

3. Modelica Library for Wavelets

The task of the new partner is to design and implement a Modelica wavelet library for signal analysis and synthesis.

4. Special skills, certification or equipment expected from the applicant

A consortium of several partners is suggested, where every partner has a specific and detailed know-how in the respective area needed for the library development.

1. Modelica media models for often used media in aircrafts

- Proven know-how of object-oriented modelling language Modelica and the Modelica.Media library
- Proven know-how of thermodynamic property models, especially in the implementation of two-phase media models.

2. Modelica Library for Converters, Electrical Machines and Basic Magnetic Models

- Proven know-how of object-oriented modelling language Modelica and the Modelica.Magnetic library
- Proven know-how of magnetic and electrical modelling
- Capable to validate models on in-house test rigs

3. Modelica Library for Wavelets

Knowledge on the wavelet theory, reliable numerical methods and Modelica know-how are required. Experience in applying wavelet methods to modelling and analyzing power electronic systems are beneficial.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Preliminary version of Modelica media models	Modelica library	31.08.2011
D2	Documentation (including validation results) and final version of Modelica media models	Modelica library and Technical report	30.11.2011
D3	Preliminary version of Modelica.Magnetic library extension	Modelica library	31.05.2012
D4	Documentation (including validation results) and final version of Modelica.Magnetic library extension	Modelica library and Technical report	30.11.2012
D5	Preliminary version of Modelica Wavelet library	Modelica library	31.08.2011
D6	Documentation (including verification results) and final version of Modelica Wavelet library	Modelica library and Technical report	30.11.2011

7. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 300.000,--
[three hundred thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

[1] Tillner-Roth, R., Baehr, H.D. An international standard equation of state for the thermodynamic properties of 1,1,1,2-tetrafluoroethane (HFC-134a) for temperatures from 170 K to 455 K at pressures up to 70 MPa. J. Phys. Chem. Ref. Data 26 (1994) 657-729.

After 3 months of the start of the project, the planned concept for the respective library has to be presented and discussed with the respective CleanSky topic manager (proof-of-concept milestone).

If no consortium applies for all three topics, a consortium that applies for two of the three topics will be also accepted.

Clean Sky Joint Undertaking
JTI-CS-2010-3-SGO-02-027

Topic description

CfP Nbr	Title		
JTI-CS-2010-3-SGO-02-027	**Simulation and Analysis Tool Development**	End date	30.11.2012
		Start date	01.12.2010

1. Background

The Systems for Green Operations ITD of Clean Sky aims to demonstrate substantial environmental and economic benefits of more electric aircraft systems technologies. The design and validation of such highly integrated systems urge the need for more co-operative development processes involving aircraft, engine, and equipment manufacturers. The design process has to be supported through advanced modelling and simulation capabilities. Therefore the goal of the consortium is to define standardised modelling methods and tools in each phase of the energy system design and validation process.

For all phases of the design process of future more electric aircraft systems, the simulation capabilities for aircraft electrical system models shall be significantly improved. The applicant should improve its Modelica modelling, simulation and analysis tool so that aircraft electrical system models can be analyzed in a much better fashion.

2. Scope of work

The Modelica tool should be improved in the following regards:

1.) Convenient DC and small signal analysis

The following features are in principal supported by a Modelica simulation tool, but the usage is too cumbersome and the goal is to provide these features so that users can easily and conveniently utilize them in a numerically reliable way:

(a) Convenient definition of DC analysis.
(b) DC transfer analysis (sweep one parameter and for every value perform a DC analysis and plot variables via this parameter).
(c) DC small signal analysis (linearize at DC operating point, compute input/output resistance)
(d) AC small signal analysis (linearize at DC operating point, perform linear analysis between a selected input to all other variables; provide at least Bode diagram and step response).
(e) DC operating point sensitivity (determine sensitivity of DC operating point with respect to selected parameters).
(f) AC small signal sensitivity (determine sensitivity of system linearized at DC operating point with respect to selected parameters).

2.) Multi-core simulation for power electronic circuits

Enhance the simulation speed for Modelica models that have many high frequency switches as well as sampled data systems as occurring in power electronic circuits. The speed-up shall be achieved by:

(a) Taking advantage of multi-core machines for one simulation run (parallelization of Jacobian calculations, as well as of model code that can be executed in parallel).
(b) Reduction of the overhead for the re-initialization at an event (by triggering only an event in the continuous part, if the continuous part is influenced by the event, by updating only the parts of the Jacobian where changes occurred, and by evaluating only the model parts in an event iteration that are influenced by the iteration).

3.) Convenient parameter studies

The goal is to interactively select Modelica parameters so that interactive parameter studies can be carried out in a convenient way:

(a) Select one or more simulation results that shall be “kept” in the plot browser and select that one of the kept simulation results will always be used as reference in the plots (so if a variable is selected for plotting, then the same variable from the reference simulation should also be shown in the same figure). It should be possible to display in a convenient way the differences of parameter and initial values between the actual simulation run and of the reference simulation.
(b) During a simulation run, allow interactive changes of a Modelica parameter although the simulation is still running. Formally, such a change of a parameter is interpreted as stopping the simulation, changing the value of the parameter and restarting the simulation.

4.) Configurable post-processing features as needed for power electronic circuits

The results of a simulation shall be analyzed in a user-configurable way, so that the usage is convenient due to the close integration into the graphical user interface of the plotting part of the Modelica tool. A “plug-in” shall be developed so that the following operations can be carried out on plot-figures:

(a) Selection of desired signals by mouse and optional selection of signal range.
(b) Providing a user-configurable menu to perform an operation on the selected signal in the defined range. The operation to be carried out can be defined by the user as a Modelica function with the selected signal in the defined range as an input argument.
(c) The tool should provide at least the following functions: FFT (Fast Fourier Transform), IFFT (Inverse Fast Fourier Transform), Fourier, THD (Total Harmonic Distortion), signal measurements (Power factor, Min/Max, Mean value, Median value, Period, Duty Cycle, Root-Mean-Square, AC coupled Root-Mean-Square, Standard Deviation, Variance, Bandwidth, Covariance of two signals).

5.) Signal observers for requirements as needed for power electronic circuits

The requirements on a model shall be mathematically formulated either as Modelica models (= requirements that can be observed continuously during simulation, e.g., a variable must be in a specified domain) or as Modelica functions (= requirements that are computed from a simulation run, e.g., fulfilment of THD requirements). It should be convenient to get an overview of the requirements and of the requirements used in a particular model. Furthermore, after every simulation run the violated requirements should be conveniently logged and displayed.

6.) Configurable automatic documentation of simulation runs

Simulation runs to be carried out shall be specified and how the results shall be automatically documented. After carrying out the defined task, the simulation runs should be automatically documented: Protocol of the runs including statistics, simulation setups (e.g. time, solver, tolerance…), listing specified parameter values, plotting defined variable values (with configurable layout for the plots), listing the used requirements observers and which of them are violated etc. The automatically generated documentation should be in a form that it can be imported in Microsoft Word.

7.) Model layers

When viewing a Modelica model, optionally not all parts are shown, but only components, connectors and connection lines that belong to a particular “layer” (e.g., show only the electrical system, but not the mechanical, hydraulic, fluid part). The definition of the “layer” should be easy and convenient. The default “layer” definition should be stored as annotation in the Modelica model, in order that the model is opened automatically with the selected default “layer”.

8.) Modelica model generation from CATIA Electrical Wiring Routing

Modelica models from the transmission lines of an aircraft should be automatically generated from CATIA Electrical Wiring Routing models, in order to support the detailed verification of the final aircraft electrical system. On the CATIA side, the lines to be exported shall be conveniently selected and from the selected lines a Modelica electrical circuit diagram should be constructed with an automatic layout of the components and of the electrical lines. The user should be able to select the level-of-detail of the generated model (e.g. only one resistance per line, or a distributed line model with storage effects).

3. Type of work

The task of the new partner is to implement improved modelling and simulation capabilities of aircraft electrical systems in his Modelica tool and demonstrate the implementation with benchmarks provided partially by consortium partners.

4. Special skills, certification or equipment expected from the applicant

The applicant must have a Modelica tool that supports the simulation of the complete Modelica Standard Library (in order to demonstrate that the tool is able to simulate complex Modelica models) and that is able to simulate power electronic circuits. The tool must support sparse matrix techniques in the integrator, in order that large electrical circuits can be simulated. The applicant must have experience to generate Modelica models from CATIA. The tool improvements must be made available in the tool as a product. For the evaluation of the result of the work, and for performing in general benchmarks with this tool in CleanSky for electrical circuits, the corresponding CleanSky consortium members must get the tool for free for these purposes within the CleanSky project.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Configurable post-processing features as needed for power electronic circuits (item 4)	Technical report and tool with this feature	31.03.2011
D2	Convenient DC and small signal analysis (item 1)	Technical report and tool with this feature	30.08.2011
D3	Model layers (item 7)	Technical report and tool with this feature	30.08.2011
D4	Multi-core simulation for power electronic circuits (item 2)	Technical report and tool with this feature	28.02.2012
D5	Convenient parameter studies (item 3)	Technical report and tool with this feature	31.05.2012
D6	Signal observers for requirements as needed for power electronic circuits (item 5)	Technical report and tool with this feature	30.08.2012
D7	Configurable automatic documentation of simulation runs (item 6)	Technical report and tool with this feature	30.08.2012
D8	Modelica model generation from CATIA Electrical Wiring Routing (item 8)	Technical report and tool with this feature	30.11.2012

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 400.000,--
[four hundred thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

Only if applicable.

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-SGO-02-028	**Support to design and test of cooling technologies**	Start date	01.11.2010
		End date	04.08.2012

1. Background

Global trends to future generation aircrafts (Fuel Burn Reduction and More Electric) imply an increased need of cooling during each flight phase as well as more complex architectures of cooling system. Ones of the most efficient cold sources for this kind of application is the surrounding airflow. The use of scoops and flush air secondary intakes to feed heat exchanger with cold air has been used for decades. However, the important increase of cooling needs and the multiplication of new customer for these cooling systems implies to control more precisely the airflow in order to optimise their use. In order to succeed the electrification of the aircraft, it is essential to design, validate and developp innovative cooling architecture. One very important part of these architectures is related to the airflow control. Indeed, the air scoops of the aircraft present the drawback of reducing the overall performance by increasing the drag. The components of the airflow system are then very critical and needs to be optimised.

Internal reference: SGO WP2.3.1.

2. Scope of work

Based on the topic manager specification, the partner shall perfom the following activities:

Design, manufacture, test and integration to the ITD Topic leader test bench an efficient airflow control system (e.g. flapper and ejector pump).

Task 1: Work Package management:

Organisation

- The partner shall maintain a single point contact who is responsible for all programmatic aspects of this contract. As part of the program management, he shall provide the necessary manpower support to accomplish the previsions of this work and show evidence of this, in a Management plan.

- The partner shall nominate a team dedicated to the project and convey to the CFP Manager the name of his key personnel. As a minimum, responsibility for the following functions shall be clearly identified:

  - Quality assurance manager
  - Chief engineer
  - Design Engineer

Progress report

- The partner shall give the CFP Manager adequate visibility on its activities, by issuing progress reports (1 every 1 months, in a free format), detailing:

  - Activities performed during the reporting period, including key points performance and mass status, risks mitigation status and schedule.
  - Delivery status (WIP chart)
  - Open actions list.

- A meeting shall be held between the partner and the CfP Topic Manager (at CfP Topic Manager facilities) in order to coordinate their respective activities.

General requirements on documentation

Documentation management

- The partner shall organize a documentation system (design, development, justification, ...) identified in the frame of this contract.

- The documentation shall be organized to fulfill the following requirements:

  - individual identification
  - ability to trace each document change,
  - allow any inquiry on the product data.
  - assure the traceability of all comprehensive and detailed justifications,
  - integration of the documents submitted to configuration management within an internal configuration status list.

Review

The following development reviews shall be held during the activities:

- Kick Off Meeting (KOM)
- Preliminary Design Review (PDR)
- Detailed Design Review (DDR)
- Before Test Review (BTR)
- After Test Review (ATR)

Preliminary Design Review

- The Preliminary Design Review shall be held before the design phase. The purpose of this review is :

  - to verify and approve the concept and predicted performance with respect to the requirements
  - to review the compliance matrices.
  - to review the preliminary justification file
  - to review the preliminary development plan and associated risks
  - to review the preliminary drawings.
  - to approve technical requirements specifications.

Detailed Design Review :

- The Detailed Design Review shall be held before assembly and tests of hardware. The purpose of this review is:

  - to review the development plan and associated tests plan
  - to review the project risks
  - to review detailed drawings and procedures

Before Test Review (BTR):

- A before test review will be held to formally present the test plan for each individual test. The purpose of this review is :

  - to formally approve the test plan.
  - to approve the detailed test procedures
  - to establish the conformance of the product units to be tested with the test requirement.
  - to verify the conformance of the test equipment, facilities and procedure with the requirements

After Test Review (ATR):

A after test will be held to formally present the test results. The purpose of this review is :

- to approve the test results

Task 2: Design, manufacture, test and integration to the ITD Topic leader test bench an efficient airflow control system (e.g. flapper and ejector pump).

Based on ITD Topic leader functional specification, the partner will design, manufacture, test and integrate the different equipment required for the air flow control and generation to an existing test bench in ITD Topic leader facilities.

The project is splitted in 4 major phases

1. Design
2. Manufacturing of the flapper
3. Validation test campaign in the partner facilities
4. Integration and test in the topic manager test facilities

The flapper will allow to control the airflow under the following conditions/requirements:

1. Airflow from 0 to 5 kg/s
2. Max air speed: 0.9 Mach
3. Air temperature range: from -55°C to +120°C
4. The control of the flapper position will allow at least 4 pre-defined positions will be permantly maintained
   A. Fully closed
   B. Min position
   C. Nominal position
   D. Fullly open position
5. Continous position adjustment for test setup
6. Position accuracy: +/-5% full open
7. Airflow pertrurbation to be minimised

The component will be delivered and integrated on the test bench of the topic manager.

The deliverable documents are expected at the end of the following phases:

1. Documents for design reviews (Preliminary Design Review, Critical Design Review) including at least:
   A. Concept score cards
   B. Justification file (in particular Aerodynamic and mechanical) including calculation methodology and results
   C. Complete drawing set
2. Manufacturing
   A. Dimensional control results
   B. Waiver form
   C. Conformity certificate
3. Test campaign on partner site

Test plan for acceptation by the topic manager including at least:

   A. Aerodynamic test results
   B. Mechanical test results
   C. Position vs airflow curve

Test report

4. Test campaign on topic manager site

Test plan for acceptation by the topic manager

User Manual

Test report , test feedback, updated design practices, tuned CFD sources and results

The use of secondary engine air flow or external air flow to feed air-oil heat exchangers induces mass impact and aerodynamic losses. The role of the air control system is of primary importance to limit these impacts. The air control system allows indeed

On one side to boost the airflow at low pressure –thanks to ejector pump for instance- and limit the size of the heat exchanger

On the other side to control the air flow at high altitude – thanks to a flapper for instance- and limit the aerodynamic impacts.

The first **challenge** is thus to optimise not only the air control system but to allow to optimise the complete cooling system from a global point of view. Different configurations designed to meet the new cooling requirements have to be compared according to criteria such as mass, reliability, flexibility, cost and SFC (Specific Fuel Consumption) impact. The partner will be requested to fill score cards with informations about the air control system to optimise the complete cooling system design.

Based on the cooling system design definition, **innovation** will be requested from the partner to optimise his components in terms of mass, reliability, cost and performance:

The ejector pump should in particular require as low air bleed as possible in order not to spoil the engine performance.

The flapper should in particular be designed

First to allow a flexible control to minimize the SFC impact (in particular complete tightness when not operating)

And to limit the power required for actuation by aerodynamic and actuator optimised design.

A **new design principle** for the flapper could in particular be a continuous control instead of discrete positions control.

3. Special skills, certification or equipment expected from the applicant

- Extensive experience in the field of **aerodynamic design** is a key factor
- Extensive experience in the field of **airflow control component** (flapper, ejector, blower) design, manufacturing and test is mandatory.
- Master in **CFD (Computational Fluid Dynamics)** is mandatory
- Experience of ITD Topic leader quality requirement and design practices is a key factor
- Relevant experience in **aerodynamic and mechanical tests** is mandatory
- Experience in calculation code validation by test results analysis
- Master of French and English languages is mandatory.
- Succession of full autonomy and on-site collaborative work periods is required.

4. Type of work

This CfP will consist in performing the test activities of some cooling technologies.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Airflow control system3D Model		PDR Airflow control system(9/2010)
D2	Airflow control system compliance Matrix to spec		PDR
D3	Airflow control system Development Plan		KOM Airflow control system(7/2010)
D4	Airflow control system Drawings		PDR
D5	Airflow control system Justification File (including aero and mechanical)		PDR
D6	Airflow control system RAMS (Reliability Availability Maintainability Safety) Report		PDR
D7	Airflow control system Risks Report		PDR
D8	Airflow control system Analysis Report		PDR
D9	Airflow control system Management Plan		KOM
D10	Airflow control systemTest Plan		BTR Airflow control system(4/2011)
D11	Airflow control system Detailed Test Description		BTR
D12	Airflow control system Test results		ATR Airflow control system(7/2011)
D13	Airflow control system Material List		PDR
D14	Airflow control system Parts List		DDR Airflow control system(1/2011)
D15	Airflow control system user manual and integration scheme		BTR topic manager test bench(7/2011)
D16	Airflow control system results, test feedback, tuned CFD sources and results and updated design practices		ATR topic manager test bench(9/2011)

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 350.000,--
[three hundred fifty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

If applicable

Topic Description

CfP topic number	Title		
JTI-CS-2010-3-SGO-02-029	**Test of advanced lubrication equipment**	Start date	01.11.2010
		End date	05.12.2013

1. Background

Oil consumption by aero-engine is a major concern for both ecological and autonomy reasons. The air-oil separation technologies (de-oiler and de-aerator) have been long time enherited from past generation engine arcitectures. Based on current oil system requirements (oil consumption, mass, compactness, reliability) and technologies (brush and lift carbon seals), ITD Topic leader develops advanced lubrication equipment.

The performance of this advanced equipment has to be validated by tests. These tests require the development of specific instrumentation and measurement devices in order to charachterise properly the equipment.

Internal reference: SGO WP2.3.1.

2. Topic Description

The partner shall perfom the following activities:

1. Design and tests demonstration of the centrifugal blower (order of magnitude of the working point : air flow 200 m3/h with a delta pressure of 10 kPa with a rotational speed of 12.000 rpm).

2. Design and tests demonstration of the air quality measurement devices. The measurement devices should measure the low oil quantity (order of magnitude 0,1 l/h) in an air flow (order of magnitude : 200 m3/h).

The blower challenges consist of:

The low speed requirement. Capacity of creating an important DP at low speed (50-60% of the maximum speed) will be of particular interest. The possibility to limit the impact of the speed on the DP or even to control the DP at high pressure (by the compressor design or by an added device like a valve) is also very useful.

The mass and size minimisation

The reliability (50.000 hours without maintenance, MTBF 1.10-7)

The integration the blower should be mounted at the end of a rotating shaft driving another equipment.

The price. The selected design should allow to meet production target costs.

The test activity challenges consist of:

The low oil quantity to measure with report to the amount of air

The requirement for a repetitive and efficient air quality measurement allowing the carachterisation of the prototype in his whole range of use:

- Air-oil ratio at the inlet will be varied from 0 to 100
- Pressure at the inlet will be varied from 15kPa to 300kPa
- Temperature at the inlet will be varied from 0°C to 180°C
- Pressure at the outlet will be varied from 15kPa to 300kPa

Task 1: Work Package management:

Organisation

- The partner shall maintain a single point contact who is responsible for all programmatic aspects of this contract. As part of the program management, he shall provide the necessary manpower support to accomplish the previsions of this work and show evidence of this, in a Management plan.

- The partner shall nominate a team dedicated to the project and convey to the CFP Manager the name of his key personnel. As a minimum, responsibility for the following functions shall be clearly identified:
    - Quality assurance manager
    - Chief engineer
    - Design Engineer

Progress report

- The partner shall give the CFP Manager adequate visibility on its activities, by issuing progress reports (1 every 1 months, in a free format), detailing:
    - Activities performed during the reporting period, including key points performance and mass status, risks mitigation status and schedule.
    - Delivery status (WIP chart)
    - Open actions list.
- A meeting shall be held between the partner and CFP Manager (at CFP Manager facilities) in order to coordinate their respective activities.

General requirements on documentation

Documentation management

- The partner shall organize a documentation system (design, development, justification, ...) identified in the frame of this contract.
- The documentation shall be organized to fulfill the following requirements:
    - individual identification
    - ability to trace each document change,
    - allow any inquiry on the product data.
    - assure the traceability of all comprehensive and detailed justifications,
    - integration of the documents submitted to configuration management within an internal configuration status list.

Review

The following development reviews shall be held during the activities:
- Kick Off Meeting (KOM)
- Preliminary Design Review (PDR)
- Detailed Design Review (DDR)
- Before Test Review (BTR)
- After Test Review (ATR)

Preliminary Design Review

- The Preliminary Design Review shall be held before the design phase. The purpose of this review is :
    - to verify and approve the concept and predicted performance with respect to the requirements
    - to review the compliance matrices.
    - to review the preliminary justification file
    - to review the preliminary development plan and associated risks
    - to review the preliminary drawings.
    - to approve technical requirements specifications.

Detailed Design Review :

- The Detailed Design Review shall be held before assembly and tests of hardware. The purpose of this review is:
  - to review the development plan and associated tests plan
  - to review the project risks
  - to review detailed drawings and procedures

Before Test Review (BTR):

- A before test review will be held to formally present the test plan for each individual test. The purpose of this review is :
  - to formally approve the test plan.
  - to approve the detailed test procedures
  - to establish the conformance of the product units to be tested with the test requirement.
  - to verify the conformance of the test equipment, facilities and procedure with the requirements

After Test Review (ATR):

A after test will be held to formally present the test results. The purpose of this review is :
  - to approve the test results

Task 2: Centrifugal blower design, tests and engineering task

Introduction

- In parallel to the test activities of air quality led in task 3, **design and test activities on an air blower** will be led in task 2.

- Based on functional specification from the topic manager, the partner shall propose concepts trade offs of blower, design, specify (including specifed requirement and drawings) and demonstrate by analysis and tests that the equipment meets all the requirements specified.

- The partner shall produce and submit for approval the **material for reviews** (see task 1). In particular, a Design Verification Matrix which shows how each specified parameter is verified.

Design

- The partner shall ensure that the blower design fulfils all the applicable requirements. For this purpose, the partner shall be responsible to achieve all the necessary tasks.

- The partner shall demonstrate the compliance to the specified requirements according to the blower specification, indicating conformance or deviation with the relevant justification.

- Any potential deviation from the applicable requirements shall be submitted to CFP Manager for approval.

- For any design issue, the partner shall suggest options and trade-off.

- The partner shall keep identification and traceability of all computerised models (2D/3D) which are shared with CFP Manager. A link between drawings and 3D models shall be established.

- The partner shall identify all critical parameters requiring CFP Manager visibility and control.

- The partner shall document and make available all design justification data.

Analysis

- The partner shall conduct analysis to demonstrate the integrity and compliance of the blower for all modes of operation and for all environmental exposures from completion of manufacture to the end of the equipment lifetime. Margins and test inaccuracies shall be quantified.

- The partner shall supply descriptions of the method of analysis when the results are presented. The partner shall also make available, if requested by CFP Manager, information concerning any computer program or computer models used in the analysis.

- All the methods and software used for the analysis shall be validated by correlation with actual data demonstrated by tests or flight performance.

- Analysis will be updated whenever changes occurs which would have a significant effect on their results.

Tests

- The partner shall issue a **Test Plan** and submit it to the CFP Manager for approval.
- The partner shall be responsible to provide all the necessary hardware, instrumentations and facilities for the test activities.
- The partner shall be responsible to performed the tests in conformity with the approved tests plan and share detailed resulted with the CFP Manager.
- The partner shall ensure the traceability and the filing of all records related to the test results.

Design verification matrix

- The Design Verification Matrix will identify all documents which demonstrate compliance of the design (performances, structural, safety and reliability aspects) with the applicable requirements.

Task 3: Air quality measurement devices, tests and engineering task

Introduction

- In parallel to the design and test activities on an air blower led in task 2, **test activities of air quality** will be led in task 3.
- The partner shall design, specify and demonstrate by tests that the **measurement devices** meets all the requirements specified.
- Thanks to the measurement device, the partner shall **perform the air quality test** of the equipment prototype.
- The partner shall produce and submit for approval the material for reviews (see task 1). In particular, a Design Verification Matrix which shows how each specified parameter is verified.

Design

- The partner shall ensure that the measurement devices design fulfils all the applicable requirements. For this purpose, the partner shall be responsible to achieve all the necessary tasks.
- The partner shall demonstrate the compliance to the specified requirements according to the measurement devices specification, indicating conformance or deviation with the relevant justification.
- Any potential deviation from the applicable requirements shall be submitted to CFP Manager for approval.
- For any design issue, the partner shall suggest options and trade-off.
- The partner shall keep identification and traceability of all computerised models (2D/3D) which are shared with CFP Manager. A link between drawings and 3D models shall be established.
- The partner shall identify all critical parameters requiring CFP Manager visibility and control.
- The partner shall document and make available all design justification data.

Tests

- The partner shall issue a **Test Plan** and submit it to the CFP Manager for approval.
- The partner shall be responsible to provide all the necessary hardware (air quality measurement devices), for the test activities.
- The partner shall be responsible to performed the tests in conformity with the approved tests plan and share detailed resulted with the CFP Manager.
- The partner shall ensure the traceability and the filing of all records related to the test results.

Design verification matrix
- The Design Verification Matrix will identify all documents which demonstrate compliance of the design (performances, safety and reliability aspects) with the applicable requirements.

3. Special skills, certification or equipment expected from the applicant

- Extensive experience in the field of **design, analysis, manufacture and test of blowers** is mandatory.
- Extensive experience in the field of **air quality measurements** is mandatory.
- Extensive experience in the field of **aerospace equipment and test** is mandatory.
- Experience of ITD Topic leader quality requirement and design practices is a key point
- Quality certification ISO 9001 and EN 9100 is mandatory
- Master of French and English languages is required.
- Succession of full autonomy and on-site collaborative work periods is required.

4. Type of work

This CfP will consist in testing some lubrication equipment.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D2.1	Air blower 3D Model		PDR Air Blower (9/2010)
D2.2	Air blower compliance Matrix to spec		PDR
D2.3	Air blower Development Plan		KOM Air Blower (7/2010)
D2.4	Air blower Drawings		PDR
D2.5	Air blower Justification File (including FEA)		PDR
D2.6	Air blower RAMS Report		PDR
D2.7	Air blower Risks Report		PDR
D2.8	Air blower Analysis Report		PDR
D2.9	Air blower Management Plan		KOM
D2.10	Air blower Test Plan		BTR Air Blower (4/2011)
D2.11	Air blower Detailed Test Description		BTR
D2.12	Air blower Test results		ATR Air Blower (7/2011)
D2.13	Air blower Material List		PDR
D2.14	Air blower Parts List		DDR Air Blower (1/2011)
D3.1	Air quality measurement device 3D Model		PDR Air quality measurement device (9/2010)
D3.2	Air quality measurement device compliance Matrix to spec		PDR Air quality measurement device (9/2010)
D3.3	Air quality measurement device Development Plan		KOM Air quality measurement device (7/2010)
D3.4	Air quality measurement device Drawings		PDR Air quality measurement device (9/2010)
D3.5	Air quality measurement device Justification File (including FEA)		PDR Air quality measurement device (9/2010)

D3.6	Air quality measurement device RAMS Report		PDR Air quality measurement device (9/2010)
D3.7	Air quality measurement device Risks Report		PDR Air quality measurement device (9/2010)
D3.8	Air quality measurement device Analysis Report		PDR Air quality measurement device (9/2010)
D3.9	Air quality measurement device Management Plan		KOM Air quality measurement device (7/2010)
D3.10	Air quality measurement device Test Plan		BTR Air quality measurement device (4/2011)
D3.11	Air quality measurement device Detailed Test Description		BTR Air quality measurement device (4/2011)
D3.12	Air quality measurement device Test results		ATR Air quality measurement device (7/2011)
D3.13	Air quality measurement device Material List		PDR Air quality measurement device (9/2010)
D3.14	Air quality measurement device Parts List		DDR Air quality measurement device (1/2011)
D3.15	Equipment prototype Test Plan		BTR Equipment prototype (5/2011)
D3.16	Equipment prototype Test Description		BTR Equipment prototype (5/2011)
D3.17	Equipment prototype Test results		ATR Equipment prototype (7/2011)

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 350.000,--
[three hundred fifty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

If applicable

Clean Sky Joint Undertaking
JTI-CS-2010-3-SGO-03-008

Topic description

CfP Nbr	Title		
JTI-CS-2010-3-SGO-03-008	**Modelling of Weather Phenomena to support Advanced Weather Radar development**	End date	31.12.2012
		Start date	01.01.2011

1. Background

Reducing CO_2 and NO_x and mitigating external noise generated by aircraft are the major environmental goals set by ACARE, the European Technology Platform for Aeronautics & Air Transport. Task of the Clean Sky JTI is to demonstrate and validate the technology breakthroughs necessary to make major steps towards the ACARE goals for 2020.

The Clean Sky Systems for Green Operations ITD, and in particular the Management of Trajectory and Mission (MTM) work package aims to demonstrate that the achievement of such results can be supported by more precise, reliable and predictable Green Trajectories, optimised for minimum noise and emission in each flight phase, including agile trajectory management in response to meteorological hazards.

In this respect, improvements in existing on-board equipments, enabling the above functions, can directly contribute to the achievement of the overall Clean Sky objectives. In particular, adding new processing features to present airborne weather radars - the main on-board sensors against meteorological hazards - can provide the pilot with a useful tool for optimising trajectories in adverse weather conditions while keeping safety margins.

2. Scope of work

The development of advanced signal processing aimed to extend and improve present capabilities of airborne weather radars requires extensive validation data to test the effectiveness and performances of proposed new features.

Unfortunately, in many cases, weather phenomena of interest are so difficult to find that performances validation by means of data collected on-site could require several months in looking for suitable data. In other cases, flying through the weather phenomenon to record real data may involve high risks of accidents to the laboratory aircraft itself.

Based on the above rationale, the present CfP aims at developing a software system able to simulate relevant weather phenomena, as they appear to advanced airborne weather radar. To implement a realistic simulation, the software development process must take into account and include the following features:

- Meteorological modelling
- Electromagnetic modelling
- Radar modelling
- Consistency verification

The required outputs of the CfP are:

- The Simulation Software Program
- The related documentation

The logical links between the above listed features are reported in Fig. 1, while a short analysis of each of them will be detailed in the next paragraphs.

The overall simulation system shall be able to provide the digital components of the polarimetric signal backscattered by the weather and received by the radar, starting from a high level description of the phenomenon itself (scenario). Such a signal will then be used as input to the evaluation system (processing system simulation software, outside the scope of the present CfP) to be developed as test bench to compare the performances of new improved weather detection algorithms with older ones.

Meteorological Model: After the analysis about occurrence and modes of the rise of the most typical weather phenomena in the European environment, their characteristics of interest to the civil aviation (hazard level, kind and intensity of precipitation, spatial extension, height, etc...) shall be derived.

Subsequently the meteorological modelling software shall be developed, which can be achieved by using/modifying existing programs/tools. It shall accept in input a suitable set of high level parameters provided through a user friendly interface and describing the scenario of the weather onset.

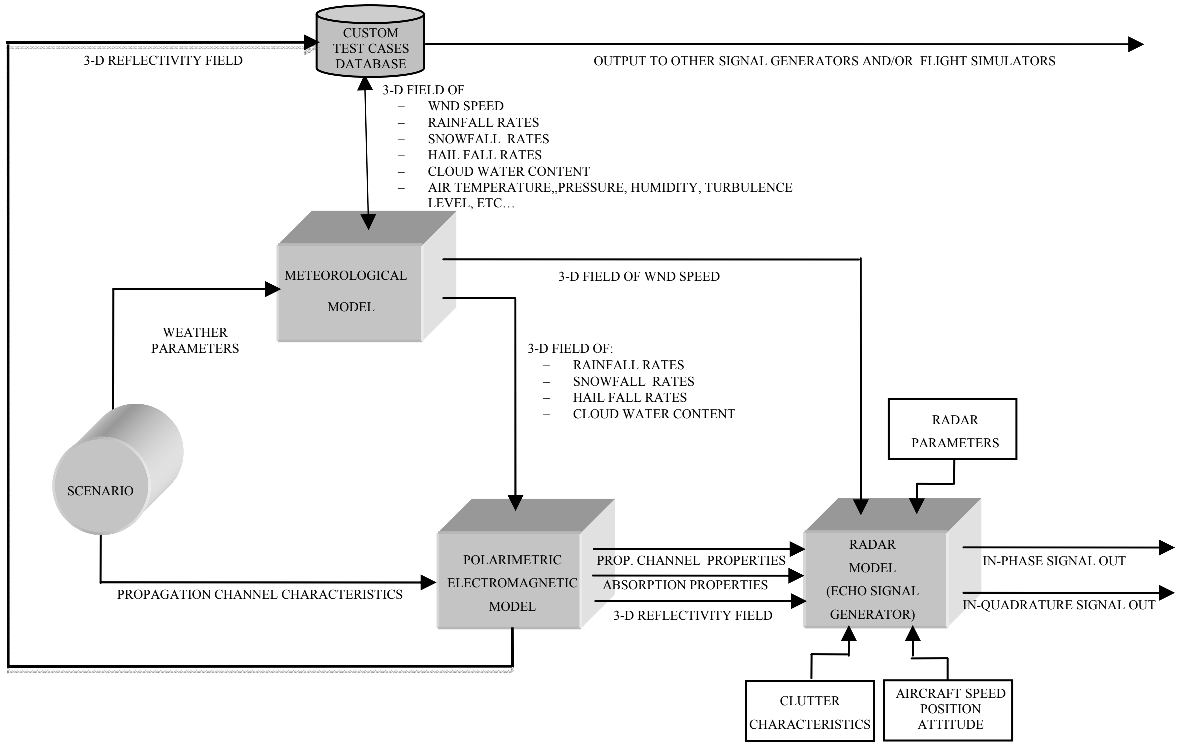


Fig.1: Block Diagram of the Weather Phenomena Simulator with main links

The model shall provide information about intensity, type of precipitation, evolution of the phenomenon, etc. and in particular (if necessary, on a denser and rotated restricted grid with respect to the coarse main scale):

- 3-D field of wind speed components to the radar model for Doppler frequencies evaluation
- 3-D field of rainfall rates and/or snowfall rates and/or hail fall rates and water content of neighbour clouds (if any) to the electromagnetic model for the reflectivity and absorption properties evaluation
- 3-D field of main meteorological parameters (air pressure, temperature, humidity, etc…) to be stored in the test database together to the above listed information

Electromagnetic Model: The electromagnetic properties of different weather phenomena shall be evaluated as a function of their characteristics and of the transmitted frequency. Electromagnetic models will be developed by upgrading existing models or by creating new ones. This activity should focus on:

Scattering: Backscattering polarimetric properties of the different particles constituting the weather phenomenon (rain, hail, snow, clouds, atmospheric dust, etc..) will be investigated according to the different characteristic of the incident wave (frequency, polarization, etc…) and cumulative (volume) properties will be derived.

Absorption: Absorption properties of the particles constituting the weather phenomenon will be evaluated in order to derive a cumulative attenuation law of the incident and reflected waves as a function of range (weather through weather) for both polarization basis (e.g. H.V.).

Propagation Channel Characteristics: According to the assumed scenario, the polarimetric properties of the propagation medium shall be derived as a function of the incident and reflected waves and of the simulated environment (presence of clouds, fog, rain, etc…) to provide a 3-D grid of absorption losses, linear/nonlinear distortions, depolarization degree, etc…

This investigation will rely on physics-based full wave simulation by taking into account complex interaction mechanisms between radiated wave and weather particles.

From the electromagnetic microphysical properties of the component particles, all the volume properties in terms of interesting radar parameters (as for example polarimetric reflectivity factor, polarimetric RCS, differential reflectivity, differential phase shift, absorption factors, etc…) shall be derived for both the simulated phenomenon and the transmission medium.

Radar Model: According to the derived electromagnetic properties, the reflected signal for each polarimetric channel shall be simulated (at video band or at intermediate frequency) taking into account its relevant characteristics (echo intensity, frequency spectrum, Doppler shift, polarization, etc…). Moreover, the simulated signal will be defined as a function of radiated wave characteristics (carrier frequency, pulse-length, pulse repetition frequency, pulse coding, pulse bandwidth, antenna boresight, antenna beamwidth, antenna scanning etc…) and noise.

The simulation shall include the effects of the coded waveforms and the characteristics of the sensor, in terms of receiving chain distortions, such as sampling jitter, amplitude and phase noise, interferences, radome effects, etc… as well as the effects due to the aircraft motions from scan to scan (roll, pitch, height, speed, Doppler shift, etc…).

Polarimetric correlated clutter background (land or sea) shall also be included and simulated by taking into account the contributions from both the antenna mainlobe and sidelobes, according to the provided antenna patterns. Clutter shall be generated from the 2-D grid of the reflectivity scattering coefficient of the area under the weather phenomenon.

The clutter echo shall be added to the weather response and both shall be taken into account to generate the final output of the radar sensor simulator in terms of the sampled In-Phase and In-Quadrature components of the received echo signal for every transmitted pulse, to be used as input to the radar processing system.

Consistency Verification: Data from ground polarimetric operating radars shall be collected and a comparison between ground truth and simulated data will be performed in order to assess the consistency of the data generated by the proposed weather simulator.

Simulation Program Characteristics; The software shall be modular in the sense that every main function shall be implemented as a single routine, able to be activated/deactivated by the user through a suitable definition file or graphical user interface (GUI).

Database: A suitable database of the weather phenomena shall be created as output from the meteorological modelling, classified according to the type of weather phenomenon and the geographic area where the phenomenon is located. The database will be used both to provide output parameters of interest for the present radar simulation and as input to previously developed echo signal generators as well as to provide information to the final flight simulator (GRACE). To ensure the compatibility of the data stored in the database with older simulation programs (at file level or by means of a suitable conversion program), at least the following data shall be stored

- 3-D grid spacing characteristics
- Eastward, northward and vertical component of wind velocity in every point of the grid
- Meteorological parameters (air pressure, temperature, humidity, etc…)
- Radar reflectivity factor in every point of the grid

Documentation: The following documentation (detailed in section 5) will be delivered during the simulator development:

a) Periodic Progress Reports

b) Technical Reports

c) Architectural Design Document, including flow diagrams, performed functions and interfaces.

d) User Manual: a user manual shall be provided to enable the user to operate with the developed software. A high level description of the program with related flow charts and I/O parameters of the key routines shall be included.

e) Executable simulator program code and its source code adequately commented in English.

3. Type of work

Development of a software package implementing a tool for modelling weather scenarios characterised from both the meteorological and the electromagnetic point of view, with the final purpose of simulating the polarimetric echo signal received by a specified radar system from different weather phenomena.

Adherence to ground truth must be validated by comparison with measured data collected during on-site dedicated test sessions using real sensors.

4. Special skills, certification or equipment expected from the applicant

The applicant is required to document its capability to satisfy all the above listed requirements, and in particular to addres the meteorological, electromagnetic and radar aspects.

A significant knowledge on modelling and simulation techniques is required and in particular, concerning the electromagnetic and radar subjects. The applicants shall describe previous experiences in such fields.

A research team with deep skills in all mentioned scientific fields is required to cover every aspect of the project.

The required programming language is C and/or MATLAB, depending on the specific functions to be implemented; such a choice is envisaged as a part of this CfP work.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.n	Periodic Progress Reports	Reports describing the activities performed in the period during the software development, test results and status of the next deliverables and review milestones. Reports on the work in progress will be issued at regular time intervals (every three-months)	T_0+ 3 x n months
D2	Meteorological Studies Report	Technical report describing the theoretical issues and the guidelines for the development of the meteorological aspects of the simulation program.	T_0+12 months
D3	Electromagnetic Studies Report	Technical report describing the theoretical issues and the guidelines for the development of the electromagnetic aspects of the simulation program.	T_0+12 months
D4	Architectural Design Document	Document including software architecture description with flow diagrams of both the overall program and single modules and routines, performed functions (algorithms and/or actions) and interfaces of each of them.	T_0+12 months
D5	Technical Report on Ground Measurements	Technical report comparing the (preliminary) results obtained by the simulation software with the data collected using the on-site (ground) polarimetric radar.	T_0+18 months

D6	Database description	Description of the scenarios included in the database and related parameters of each of them.	T_0+20 months
D7	Simulation Software Package including: - Source Code - Code executable for Windows	Software package with source code in C language and/or updated version of MATLAB, with comments in English both on main program and on the key routines, with close references to the Software Architecture Document.	T_0+24 months
D8	Simulator User Manual	Manual describing the use of the system software simulator to enable the user to generate the simulated data to be entered to the radar processing simulator or/and to be stored in the database. A high level program description, flow charts and I/O parameters of main routines must be included.	T_0+24 months

T_0 refers to the kick-off date of this project.

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 750.000,--
[seven hundred fifty thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

Management policy:

- In proposal the applicant must provide a Gantt diagram of the work, dividing the required activities in clearly defined work packages and indicating for every WP time schedule, required input and delivered output, in accordance with the scheduled deliverables listed at the previous section 5.
- Management & progress meetings shall be periodically planned along the project, to evaluate activities progress, give feedback on requirements and result assessments, prepare milestones and reviews, and deal with project management issues.
- Technical meetings shall take place on SGO Topic' s manager request, in order to discuss in details specific technical points.

Topic description

CfP Nbr	Title		
JTI-CS-2010-3-SGO-04-001	**Design and manufacture of an aircraft tractor compliant with specifications for Smart Operations on ground**	End date	01.10.2011
		Start date	01.10.2010

1. Background

Clean Sky Systems for Green Operations aims developing systems that will reduce the environmental impact of the aircraft. In this project, work package 4 (WP4) aims at demonstrating the technical solutions for large aircraft application, both on ground test rigs and flight test aircraft.

The Dispatch Towing that consists in towing aircraft with engine off from gate to runway has been identified as a promising solution for greener aircraft operations. Today's aircraft have not been designed for this kind of operation. On the other hand, a procedure such as the Dispatch towing will be defined only if it can be applicable to all the aircraft operating on a platform. As a consequence, the design of a specific Dispatch Towing Vehicle (DTV) is required to overcome the limitations of current aircraft.

This DTV prototype will then be used during trials with real aircraft to validate its performance and its compliance to the defined requirements in order to prove the relevance of the concept.

2. Scope of work

The expected work is to design and manufacture a specific Dispatch Towing Vehicle (DTV) able to perform Dispatch Towing regardless the limitations of current aircraft. This platform is a TRL6 demonstrator of the Dispatch Towing concept.

This vehicle will have to fulfil the following requirements:

- The DTV must fulfil the International Standard used for Aircraft ground equipments (when applicable). The list of these standards is given in section 7.
- The DTV must tow aircraft at a speed compatible with the integration into the taxiing traffic.
- The DTV must not impact the structure life of the aircraft, and specifically the fuselage and the nose landing gear (it is the main limitation of current tow tugs)
- The aircraft pilot must be able to drive the DTV as long as it is attached to the aircraft; the behaviour of the DTV during turns and braking must give the feeling to the pilot that he is directly in control of the aircraft
- The DTV must propose a solution that ensures the safety of the aircraft during the towing operation: localisation, obstacle detection and aircraft guidance…
- The DTV must be universal in its aircraft category. Three aircraft categories are identified:
    - Regional aircraft
    - Single aisle (e.g. A320…)
    - Twin aisle (e.g. A330, A380…)
- The DTV must propose solutions to improve the reliability level compared to current towing vehicles
- The DTV may propose green solution for its own power system

The applicant will design and build a prototype of DTV for single aisle or for twin aisle aircraft family.

The technical concept will be validated versus requirements thanks to a dedicated analysis.

The necessary technologies will be developed or acquired by the applicant. Most of them already exist in other industries (e.g. automotive). Airbus is currently working on the demonstration of some of these technologies. They are not the property of Airbus, and the applicant has the freedom to acquire them by negotiating directly with the technology owner before answering to this CfP.

The value of the proposal will come from the integration of these technologies into a single vehicle fulfilling the requirements. The relevant aircraft data will be provided on demand by Airbus during the negotiation phase with the selected applicant.

The purpose of Clean Sky is to evaluate and validate the performance of this demonstrator in a real operational use case. Hence the demonstrator will have to be physically delivered for some validation tests in France and the selected partners shall offer support during a 6 weeks trial period.The physical property of the demonstrator belongs to the applicant unless other agreement during the negotiation report.

3. Type of work

The expected work will cover specification, design and manufacturing aspects.

4. Special skills, certification or equipment expected from the applicant

The applicant must have experience on the manufacturing of ground vehicles for industrial application, and must show a deep understanding of the aircraft towing technical stakes.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date (indic.)
D1	DTV Specifications		01.12.2010
D2	DTV Validation Report	Analysis showing the compliance of the selected technical solution versus the requirements	31.05.2011
D3	DTV Prototype		30.09.2011

6. Topic value (€)

The total value of biddings for this work package shall not exceed :

€ 2.000.000,--
[two millions euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program

7. Remarks

List of applicable International standard (not exhaustive) for the development of the DTV.

ISO	6966-1	Aircraft Ground Equipment – Basic Requirements – Part 1: General Design Requirements
	6966-2	Aircraft Ground Equipment – Basic Requirements – Part 2: Safety requirements
	20683-1	Aircraft Ground Equipment – Design, Test and maintenance for towbarless towing vehicles (TLTV) interfaced with nose landing gear – Main line aircraft
SAE	ARP1247C	General requirements for Aerospace Ground Support Equipment, Motorized and Non motorized
	AIR 1328	Aircraft support equipment stability analysis
	AIR 1375B	Minimum Safety Requirements for special purpose airline ground support equipment
	AIR 1838	Pictograms for ground support equipment
	ARP 4852	Design Specification for towbarless push-back tow vehicles
	ARP 4853	Design specification for towbarless tow vehicles
	ARP 5283	Nose gear towbarless tow vehicle basic test requirements
	ARP 5284	TLTV – Aircraft NLG steering and tractive force protection systems or alerting devices – inspection, maintenance and calibration requirements
	ARP 5285	Towbarless towing vehicle operating procedure
EN	12312-7	Airvraft movement equipment

Clean Sky - Technology Evaluator

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-TEV	Clean Sky - Technology Evaluator	0		

No topics from Technology Evaluator are included in this call.