Clean Sky Joint Undertaking
Call SP1-JTI-CS-2010-01

European Commission
Research Directorates

Call for Proposals:

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

Call Text

Call Identifier

SP1-JTI-CS-2010-01

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- Topic manager (not to be published)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.

Clean Sky Joint Undertaking
Call SP1-JTI-CS-2010-01

European Commission
Research Directorates

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-ECO	**Clean Sky - EcoDesign**	**2**	**1.046.000**	**784.500**
JTI-CS-ECO-01	*Area-01 - EDA (Eco-Design for Airframe)*		**400.000**	
JTI-CS-2010-1-ECO-01-003	Development of Chromium free dense and thin micro-arc coatings for corrosion protection of light alloys (Al and Mg)		400.000	
JTI-CS-ECO-02	*Area-02 - EDS (Eco-Design for Systems)*		**646.000**	
JTI-CS-2010-1-ECO-02-004	Electrical test bench drive systems: mechanical interfaces		646.000	
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	**12**	**2.025.000**	**1.518.750**
JTI-CS-GRA-01	*Area-01 - Low weight configurations*		**1.075.000**	
JTI-CS-2010-1-GRA-01-026	Reliability Oriented Optimisation of Structural Replacement Strategies		150.000	
JTI-CS-2010-1-GRA-01-027	Design and manufacturing of smart composite panels for wing applications and development of structural health monitoring techniques		120.000	
JTI-CS-2010-1-GRA-01-028	Nano Modification of CFRP Resin		80.000	
JTI-CS-2010-1-GRA-01-029	Definition of requirements and tests of practicability		75.000	
JTI-CS-2010-1-GRA-01-030	Advanced Lightning tests on a few material types for aviation		150.000	
JTI-CS-2010-1-GRA-01-031	Functional laminates development. Components compatibility and feasibility assessment. Industrialization		200.000	
JTI-CS-2010-1-GRA-01-032	Resin, Laminate and Industrial Nanoparticles Concept and Application. Industrialization		180.000	
JTI-CS-2010-1-GRA-01-033	Trade-off study for the ranking of new technologies best fitting wing		120.000	
JTI-CS-GRA-02	*Area-02 - Low noise configurations*		**800.000**	
JTI-CS-2010-1-GRA-02-007	Wing/pylon/nacelle/HLD for advanced regional TF A/C configuration by multidisciplinary design with aero-elastic constrains		450.000	
JTI-CS-2010-1-GRA-02-008	Efficient CFD multiphysics programming research		150.000	
JTI-CS-2010-1-GRA-02-009	Adaptive wing structure concept for load matching		200.000	
JTI-CS-GRA-03	*Area-03 - All electric aircraft*			
JTI-CS-GRA-04	*Area-04 - Mission and trajectory Management*		**150.000**	
JTI-CS-2010-1-GRA-04-002	ATM operational requirements (collection of information regarding ATM operational requirements, available regulation, safety requirements and future expected features)		150.000	
JTI-CS-GRA-05	*Area-05 - New configurations*			
JTI-CS-GRC	**Clean Sky - Green Rotorcraft**	**4**	**4.844.000**	**3.633.000**
JTI-CS-GRC-01	*Area-01 - Innovative Rotor Blades*		**400.000**	
JTI-CS-2010-1-GRC-01-004	Performance/benefit assessment of advanced rotor configurations including active and passive blades		400.000	
JTI-CS-GRC-02	*Area-02 - Reduced Drag of rotorcraft*		**1.725.000**	
JTI-CS-2010-1-GRC-02-004	Contribution to design optimisation of tiltrotor for drag (fuselage/wing junction, nose, landing gear, empennage)		898.000	
JTI-CS-2010-1-GRC-02-005	Contribution to the aerodynamic design optimisation of a helicopter fuselage including its rotating rotor head.		827.000	
JTI-CS-GRC-03	*Area-03 - Integration of innovative electrical systems*			
JTI-CS-GRC-04	*Area-04 - Installation of diesel engines on light helicopters*		**497.000**	
JTI-CS-2010-1-GRC-04-002	Participation to the definition of optimal helicopter architecture for Diesel engine		497.000	
JTI-CS-GRC-05	*Area-05 - Environmentally friendly flight paths*			
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	**1**	**1.000.000**	**750.000**
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*			
JTI-CS-2010-1-SAGE-03-001	Fan annulus filler development		1.000.000	
JTI-CS-SAGE-04	*Area-04 - Geared Turbofan*			
JTI-CS-SAGE-05	*Area-05 - Turboshaft*			
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	**18**	**6.350.000**	**4.762.500**
JTI-CS-SFWA-01	Area01 – Smart Wing Technology		**5.850.000**	
JTI-CS-2010-1-SFWA-01-004	Support of icing-tests (runback-ice behaviour of surfaces) and icing mechanisms		230.000	
JTI-CS-2010-1-SFWA-01-005	Support of development of riblet-application device		260.000	
JTI-CS-2010-1-SFWA-01-006	Concept for automated riblet-application (robot-concept)		260.000	
JTI-CS-2010-1-SFWA-01-007	In field surface inspection tool (for bonded repair)		150.000	
JTI-CS-2010-1-SFWA-01-008	Construction and assembly of a prototype surface pre-treatment tool for in-field use		150.000	
JTI-CS-2010-1-SFWA-01-009	Protoype of curing tool		150.000	
JTI-CS-2010-1-SFWA-01-010	Phased array ultrasound and NDT measurements		150.000	
JTI-CS-2010-1-SFWA-01-011	Prefabricated CFRP Parts		150.000	
JTI-CS-2010-1-SFWA-01-012	Concept study: Cleaning device for wing leading edge		40.000	
JTI-CS-2010-1-SFWA-01-013	Active Flow Control (AFC) techniques on trailing edge shroud for improved high lift configurations - design, manufacture and tests		460.000	
JTI-CS-2010-1-SFWA-01-014	Manufacturing of the test set up for gust load alleviation in the Onera S3Ch WT facility		400.000	
JTI-CS-2010-1-SFWA-01-015	Development and test of a fluidic actuator prototype (MEMS type) on aircraft level		190.000	
JTI-CS-2010-1-SFWA-01-016	Ultra low power autonomous wireless stain gauge data acquisition unit		800.000	
JTI-CS-2010-1-SFWA-01-017	Fluidic sensor for separation detection in flight – development, design, C&M, and tests		610.000	
JTI-CS-2010-1-SFWA-01-018	Development and test of subsystem of active flow control actuator based on pneumatic principles		290.000	
JTI-CS-2010-1-SFWA-01-019	Flown Control Actuator System development, manufacture and demonstration for high lift		620.000	
JTI-CS-2010-1-SFWA-01-020	Structural designs and tests for integration of active flow control concepts on trailing edge high lift device		940.000	
JTI-CS-SFWA-02	Area02 – New Configuration		**500.000**	
JTI-CS-2010-1-SFWA-02-006	Design and manufacture of a ground-based structural/systems demonstrator		500.000	
JTI-CS-SFWA-03	Area03 – Flight Demonstrators			
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	**8**	**3.545.000**	**2.658.750**
JTI-CS-SGO-01	*Area-01 - Definition of Aircraft Solutions and explotation strategies*			
JTI-CS-SGO-02	*Area-02 - Management of Aircraft Energy*		**3.245.000**	
JTI-CS-2010-1-SGO-02-012	Saber Electrical Benchmark		200.000	
JTI-CS-2010-1-SGO-02-013	Test Bench for global cooling solutions validation		500.000	
JTI-CS-2010-1-SGO-02-014	Construction of evaluation Power Modules (10) to a given design		175.000	
JTI-CS-2010-1-SGO-02-015	Current return simulation (methodology & tool)		300.000	
JTI-CS-2010-1-SGO-02-016	Thermal exchange modeling and power optimization		500.000	
JTI-CS-2010-1-SGO-02-017	Integration study of Electro-thermal and Electro-mechanical Ice Protection devices in an A320 slat.		370.000	
JTI-CS-2010-1-SGO-02-018	Design, manufacturing, integration and validation of AFD function		1.200.000	
JTI-CS-SGO-03	*Area-03 - Management of Trajectory and Mission*		**300.000**	
JTI-CS-2010-1-SGO-03-007	Parametric optimisation techniques for on-board trajectory shaping under constraints		300.000	
JTI-CS-SGO-04	*Area-04 - Aircraft Demonstrators*			
JTI-CS-SGO-05	*Area-05 - Aircraft-level assessment and exploitation*			
JTI-CS-TEV	**Clean Sky - Technology Evaluator**	**0**		
		topics	**VALUE**	**FUND**
	totals (€)	**45**	**18.810.000**	**14.107.500**

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:** **29 January 2010**
- Information Day: 9 February 2010
- **Call close:** **27 April 2010, 17:00**

- Evaluations (indicative): 17-21 May 2010

- Start of negotiations (indicative): 14 June 2010
- Final date for signature of GA by Partner: 31 August 2010
- Final date for signature of GA by Clean Sky JU: 10 September 2010

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

info-call-2010-01@cleansky.eu

All questions received until end of March 2010 will be answered.
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-2010-01
ECODESIGN

Clean Sky - EcoDesign

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-ECO	**Clean Sky - EcoDesign**	**2**	**1.046.000**	**784.500**
JTI-CS-ECO-01	*Area-01 - EDA (Eco-Design for Airframe)*		**400.000**	
JTI-CS-2010-1-ECO-01-003	Development of Chromium free dense and thin micro-arc coatings for corrosion protection of light alloys (Al and Mg)		400.000	
JTI-CS-ECO-02	*Area-02 - EDS (Eco-Design for Systems)*		**646.000**	
JTI-CS-2010-1-ECO-02-004	Electrical test bench drive systems: mechanical interfaces		646.000	

Clean Sky Joint Undertaking
JTI-CS-2010-2-ECO-01-003

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-ECO-01-003	Development of Chromium free dense and thin micro-arc coatings for corrosion protection of light alloys (Al and Mg)	End date	*T0+24 (01/07/2012)*
		Start date	*T0 (01/07/2010)*

1. Topic Description

Background

Aluminium and magnesium alloys are widely used in aircraft and rotorcraft:

Nowadays, 95% of aluminium parts are protected by surface treatments in order to prevent from corrosion: Chromic Acid Anodizing (CAA) coupled with its dichromate sealing conversion coating (Alodine®) with or without painting and varnish. These protections contain the CMR compound Cr^{6+} or use it in their process (Cr^{6+} is used in the baths during the process, in the layer of conversion, in painting or in varnish).

Magnesium alloys have a high susceptibility to corrosion. In the past many efforts were done to optimize the protection level of magnesium components in operating environment. Good corrosion behaviour with relatively high maintenance costs has been reached by mean of typical Cr^{6+} loaded protection schemes including conversion coating with varnish or painting.

Nowadays, surface treatments for corrosion protection of both aluminium and magnesium alloys use the CMR compound Cr^{6+}. The Clean-Sky project aims at developing green technologies that meet the European regulations such as the REACH regulation. Micro-arc oxidation (MAO), also called plasma electrolytic oxidation (PEO) or anodic spark oxidation could be a good alternative process for replacing:

- CAA with sealing when used for aluminium unpainted parts,
- CAA with/without sealing before painting primer on aluminium alloys
- CAA when used as a masking prior to hard anodizing of aluminium alloys. It could be interesting to develop only one process that reaches CAA & Hard anodizing properties.
- Chromium conversion coating with and without varnish before painting primer on magnesium alloys.

Micro-arc coating fulfils the REACH requirements on condition that electrolyte does not contain any hazardous ionic species. Most of these new processes are already on the industrial market and some laboratory characterisation on samples (corrosion, galvanic corrosion, fatigue) have been done but the application to aircraft components must be developed.

Moreover, for aluminium alloys applications, contrary to CAA, it requires neither surface preparation (sulphochromic acid) before treatment nor sealing after treatment. The specific properties of MAO must answer to CAA requirements regarding corrosion and could have the same properties as hard anodising regarding hardness and wear resistance. The main difficulty here is the thickness of micro-arc layers. They are by far thicker than CAA layers. It means that it is not possible to use micro-arcs anodising on current parts without drawing changes. Thus there is a strong need to adjust the process parameters to obtain thinner coatings (<5µm) in order to be compliant with CAA requirements.

For magnesium alloys, micro-arc processes have been developed. Their corrosion protection level with or without Cr^{6+} free varnish & primer must be optimized in order to be compliant with chromium conversion coating requirements. Moreover, thickness should be less than 15 µm.

A first short study performed during the scoping phase of the Clean Sky project has already shown promising results (300h salt spray test with a 5 µm thick layer – ISO 9227) at the laboratory scale on one aluminium alloy (2024). The trials on magnesium will need optimization of the process parameters (bath composition, electrical parameters) to obtain thin layers with interesting properties.

Scope

The aim of this CfP is to find a partner or a consortium (a group composed of suppliers and research laboratories), that will propose a 2 years research program for developing thin micro-arc coatings that will demonstrate good corrosion protection for both aluminium and magnesium alloys. The effect of the nature of the substrate (cast, laminated, forged…) will be also evaluated and a part of the study will be focused on process optimization for reducing energy consumption.

The applicant will have facilities for developing micro-arc coatings but also for characterizing them through salt spray testing, electrochemical measurements, microstructural observations, thickness measurements, roughness... It is also strongly required that the group of partners will have facilities for implementing the process in an industrial scale. For magnesium alloy it will mean to apply the micro-arc coating to a relatively complex shape typical of transmission case castings with machined areas to demonstrate thickness uniformity and low surface roughness (≤1.6 Ra). The interaction between coating and sealing resin for corrosion protection shall be also evaluated.

For the development of thin coatings, several routes could be explored. For example:

- The effect of the distance sample-electrode,
- Tests of several electrolytes
- Study of electrical parameters with 2 or 3 different generators (electrical with constant frequency, electronic with various frequencies….)
- …

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

The applicants should dispose of facilities for:

- Developing thin micro-arc coatings
- Characterizing developed coatings through salt spray testing, electrochemical measurements, microstructural observations, roughness and thickness measurements…

It is also strongly required that the applicant will have facilities for implementing the process in an industrial scale.

2. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
1	Intermediate report	Report	T0+6
2	Mid-term report	Report	T0+12
3	Intermediate report	Report	T0+18
4	Final report	Report	T0+24
5	Coating(s) for aluminium alloys, compliant with requirements	Small Demonstrators	T0+24
6	Coating(s) for magnesium alloys, compliant with requirements	Small Demonstrators	T0+24

3. Topic value (€)

The total value of 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 programme

4. Remarks

References to REACH REACH http://ec.europa.eu/enterprise/sectors/chemicals/reach/index_fr.htm

Clean Sky Joint Undertaking
JTI-CS-2010-1-ECO-02-004

Topic Description Sheet

Topic Nr.	Title		
JTI-CS-2010-1-ECO-02-004	Electrical test bench drive systems: mechanical interfaces	End Date	To+14 M
		Start Date	To (01.07.2010)

1. Topic Description

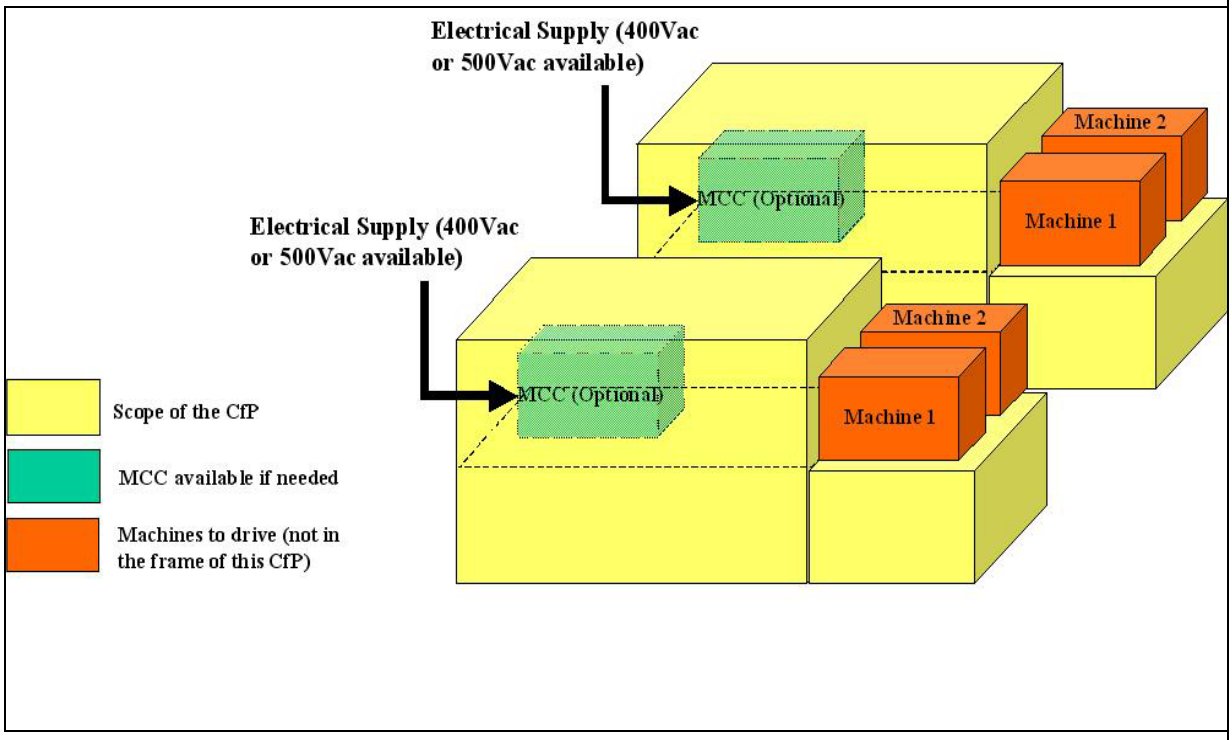
Background:

In the frame of the Eco-Design ITD, airframers will use an Electrical test bench. This test bench will have the capability to simulate electrical start of the aircraft engine, as well as electrical generation.
The Electrical test bench is already equipped with 2 driving DC motors that could be used in the proposed solution, with respective capacities of 400 kW and 500 kW and associated electronics. The starter/generators are not in the scope of this Call for Proposal.

Scope of work:

Subject of this call for proposal is the design, manufacturing, commissioning and validation of two complete and identical driving systems for the starters/generators for the ground test bench.

The objective is to provide the mechanical means to drive two "systems" including one set [machine 1; machine 2] each, based on reversible driving electrical motors in order to simulate one aircraft engine from an electrical generation and starting system point of view.
Each system (which are identical) will drive a starter/generator (machine 1) and a generator or a second starter/generator (machine 2)



Technical information:
Technical characteristics of each machines are not totally defined yet, but for each machine (1 and 2) the system should be able to meet these requirements:

Machine 1:
- Reversible machine (both operated in starter and generator)
- Speed range: 0 – 16000 rpm
- Max power: 150kW
- Weight: 50 kg max
- Air or oil cooled

Machine 2:
- Generator
- Speed range: 0 – 20000 rpm
- Max power: 120kW
- Dry Weight: 50 kg max
- Oil cooled

The machines 1 and 2 should be perfectly synchronised (mechanical coupling or driving system synchronisation for example).

The system will include:
- Mechanical driving system
- Torque measurement
- Speed measurement
- Mechanical coupling of the machines
- System supporting frame
- System internal cabling

The system will not include:
- Machine 1
- Machine 2
- Electrical power supply cabling
- 2 DC motors if relevant

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

The proposal should include:

- Detailed study of the solution
- Manufacture of the system
- Integration and commissioning
- Validation of the systems

The system should be innovative, either by the solution, or by technology, materials. As leads, you may explore fields like:
- Torque transducers to minimize the shaft's length (torque flange sensors, etc.)
- If used, the reducers/multipliers gears' design should have a very high efficiency by using an innovative technology (superlubricity, oil-less, etc.) and/or the possibility to desynchronized machine 1 and machine 2.
- If no reducers/multipliers are used, very high speed (> 45000 rpm) direct drive system solutions could be explored.

Obviously, the innovative technology possibilities are not reduced to the leads describe above and the applicants are free to propose their solutions to obtain an innovative test bench mechanical drive system.

The systems will be as compact as possible.
The systems will use as few lubrication systems and servitudes as possible.

The scope of the CfP is design, manufacture, integration and validation of two systems, integrating the same characteristics.

2. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	PDR	Preliminary Design Review	T0 + 3
D2	CDR	Critical Design Review	T0 + 6
D3	Manufacturing	Delivery of the complete systems	T0 + 12
D4	Commissioning	Commissioning of the complete systems	T0 + 14

4. Topic value (€)

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

€ 646.000,--

[Six hundred forty six thousand euro]

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

5. Remarks

Clean Sky - Green Regional Aircraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	**12**	**2.025.000**	**1.518.750**
JTI-CS-GRA-01	*Area-01 - Low weight configurations*		**1.075.000**	
JTI-CS-2010-1-GRA-01-026	Reliability Oriented Optimisation of Structural Replacement Strategies		150.000	
JTI-CS-2010-1-GRA-01-027	Design and manufacturing of smart composite panels for wing applications and development of structural health monitoring techniques		120.000	
JTI-CS-2010-1-GRA-01-028	Nano Modification of CFRP Resin		80.000	
JTI-CS-2010-1-GRA-01-029	Definition of requirements and tests of practicability		75.000	
JTI-CS-2010-1-GRA-01-030	Advanced Lightning tests on a few material types for aviation		150.000	
JTI-CS-2010-1-GRA-01-031	Functional laminates development. Components compatibility and feasibility assessment. Industrialization		200.000	
JTI-CS-2010-1-GRA-01-032	Resin, Laminate and Industrial Nanoparticles Concept and Application. Industrialization		180.000	
JTI-CS-2010-1-GRA-01-033	Trade-off study for the ranking of new technologies best fitting wing		120.000	
JTI-CS-GRA-02	*Area-02 - Low noise configurations*		**800.000**	
JTI-CS-2010-1-GRA-02-007	Wing/pylon/nacelle/HLD for advanced regional TF A/C configuration by multidisciplinary design with aero-elastic constrains		450.000	
JTI-CS-2010-1-GRA-02-008	Efficient CFD multiphysics programming research		150.000	
JTI-CS-2010-1-GRA-02-009	Adaptive wing structure concept for load matching		200.000	
JTI-CS-GRA-03	*Area-03 - All electric aircraft*			
JTI-CS-GRA-04	*Area-04 - Mission and trajectory Management*		**150.000**	
JTI-CS-2010-1-GRA-04-002	ATM operational requirements (collection of information regarding ATM operational requirements, available regulation, safety requirements and future expected features)		150.000	
JTI-CS-GRA-05	*Area-05 - New configurations*			

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRA-01-026

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-01-026	Reliability Oriented Optimisation of Structural Replacement Strategies	**Start date**	*T0 (**)*
		End date	*T0+18*

1. Topic Description

The proposal shall not comprise more than 30 pages.

***Short description**:* GRA ITD intends to address low weight structures using a built-in real-time structural health monitoring (SHM) system. Unlike traditional NDE systems, the SHM system is designed to apply to a specific structure with a built-in network of sensors and actuators. Especially for composite aircraft structures where the incidence of fatigue is low, this technique could potentially be economical and reduce the weight of the structures reducing the uncertainly for the damage identification. Anyway the routine has to be applied also for hybrid and metallic structures.

The optimisation of a full scale component (Fuselage, Wing) for minimum weight have has to be done considering the possibility that the real component has more that one approach for design and thus damage identification (NDT, SHM, for safe life, fail safe, damage tolerance approach). The final design is correlated to an appropriate maintenance and minimises the weight while maintaining the safety for the minimum maintenance cost. This is due in order to built a valid alternative to conventional NDT. As consequence the aim of this work is to set the basis for and develop a software module for an intelligent inspection and maintenance process. It is embedded in the context of damage localisation and sizing in structures that include sensorized panels.

1.1 Introduction

The software shall perform a reliability oriented cost optimisation of structural inspection and replacement strategies, based on Bayesian statistical decision theory. The methodology has to be applied on a (2mx3m) stiffened panel in which the geometry and load condition are given by the ITD. The optimisation requires the implementation of algorithms for the computation of the structural reliability conditional on SHM information, (inspection results and on maintenance actions) for a safe life, fail safe and damage tolerance approach. These algorithms shall be developed for random variable and random process models and shall use Bayesian techniques. Interfaces to the models of the stiffened panel and the SHM will be established based FEM model and/or on response surface techniques. The optimisation will be of total expected life-cycle cost.

1.1.1 Background

The proposed work fits in the three work packages of GRA LWC “Enabling Technologies for Design”, “Enabling Technologies for Maintenance” and “LWC Definition of Demonstrator”.

1.1.2 Interfaces to ITD

The details of the integration of the developed module into the GRA LWC platform will be defined together with the successful applicant. The winner has to be able to modify the code due to the necessity to have a link with already existing code, running under Windows and / or Linux. A purely commercial code would not be sufficient.

1.2 Reference documents NA

1.3 Scope of work: The scope of the work is the development of a cost optimisation methodology for the inspection and replacement/repair process based on probabilistic damage and inspection models. The methodology/code will be integrated in a numerical procedure, given by ITD, for the optimisation of the structure, for the minimum weight. The optimisation problem shall be the minimization of the life-cycle cost according to expected cost principles under time variant boundary conditions. Sensor and inspection results must be accounted for by means of Bayesian analysis. The methodology shall address safe life; fail safe, damage tolerance and self-sensing structures. The project shall result in cost benefits by ensuring and documenting a specified reliability with minimum inspection and maintenance efforts.

1.4 Type of work: The type of work to be performed is the development and description of the theory, its implementation into a software code, and the demonstration of the software with a stiffened panel provided by the ITD. The panel will be in the form of FEM model and/or response surface.

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

The applicants must be familiar with developing software tools using a high level programming language. Specifically, the applicant should have significant experience in developing, distributing and maintaining software related to reliability analysis and optimization for industrial applications.

The applicants should have a background in design and maintenance requirements for aircrafts.

The applicants should have experience from participation in international research projects.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Code architecture and theory for the optimised inspection cost determination	Description of software architecture including an outline of theory.	T0 + 3 month
D2	Description of the Maintenance strategies including reliability, decision making mechanism and optimisation routine identification.	Detailed description of theory.	T0 + 12 month
D3	Maintenance strategy code	Code is provided and the data flow is described.	T0 + 15 month
D4	Maintenance strategy validation	Demonstration of software the ITD stiffened panel	T0 + 18 month

4. Topic Value

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. Remarks

If applicable

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRA-01-027

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-01-027	Design and manufacturing of smart composite panels for wing applications and development of structural health monitoring techniques	Start date	T0
		End date	T0+7

1. Topic Description

***Short description**:* The main targets of this CfP are the design, manufacture, mechanical characterisation, sensorisation and health status analysis of carboresin unstiffened and stiffened panels for wing applications. Geometries and materials specifications are provided here, competences in composite panels design and manufacturing, mechanical characterisation rules, optimation of number and position of sensors with FEM modelling and health monitoring innovative approaches are required.

1.1 Introduction

1.1.1 Background:

One of the main objectives of Air Green is the development of a SHM (Structural Health Monitoring) system for the detection of impacts on composite panels (in real time) and identification and localization of impact damages (off line).

The SHM will be constituted by an array of piezo-patches acting both as sources and receivers at the proper frequency ranges in order to excite symmetrical and anti-symmetrical lamb-waves in the structure.

Experimental tests for impact detection and damage identification will be carried out in the Air Green laboratories on composite stiffened and unstiffened panels built through this CfP.

Furthermore numerical optimisation of number and position of the sensors (piezo-patches) for detection of low-velocity impact as well as for health monitoring analysis by the mean of “lamb waves” excitation and sensing represent one of the tasks to be accomplished employing explicit finite element transient analysis.

Air Green is also interested in developing, assessing and optimizing a damage detection technique based on the POD (Proper Orthogonal Decomposition) technique applied to the measurement of vibration response data (displacements, velocities, accelerations).

The activity conducted in the framework of WP 1.3.4 has been focused on extending the methodology, already developed for beam-like structures, to 2D components. Some numerical tests have been performed in order to assess the capabilities of the approach in detecting damages of different kinds (cracks, delaminations), of different sizes, and at different locations. Also the effect of different exciting forces has been investigated.

A key aspect of the POD methodology is the need of the dynamic response data for both the undamaged and the damaged structure; this may be limiting in terms of applicability to on-line structural health monitoring. The possibility to calculate the POD damage index without the need of the undamaged structure’s dynamic response has to be investigated.

1.1.2 Interfaces to ITD: The work is integrated within the WP1 activities since one of its main objectives is the development and testing of innovative health monitoring approaches for wing panels. This activity should permit to provide panels completely characterised for what concerning mechanical properties and production defects. Furthermore, sensorisation of the panels is included in order to provide test articles for which sensors locations will be numerically optimised towards the specifications of impact detection and damage analysis as provided within WP1.3.1. Furthermore, the activity required for the improvement of the POD-based damage detection technique will be integrated into the framework of the WP 1.3.4 activities.

A kick-off meeting will be held at the beginning of the project object of this call in order to
(i) supply the documentation about the activities performed at that time,
(ii) Supply the needed input data,
(iii) Decide how to manage the data exchange during the project.

- **Reference documents**

ASTM International – American Society for Testing and Material

1.3 Scope of work

The aim of the work is the design and manufacturing of composite CFRP unstiffened and stiffened panels. For all the items the mechanical properties and NDE (Non Destructive Evaluation)results have to be provided.

As for the POD-based damage detection technique, the scope of the activity object of this call is to improve the already developed methodology in such a way that only the dynamic response data of the damaged structures are needed.

1.4 Type of work

Task 1

Design and manufacturing of unstiffened and stiffened carbon/epoxy composite panels, material characterization, non-destructive evaluation of the manufactured items and sensorisation of the panels including optimisation of sensors/actuators locations

Subtask 1.1

Configuration of panels, number of items and material types to be provided:

Configuration and in-plane dimensions	**Skin Lay-up and materials (as an example)**	**Thickness (mm)**
Unstiffened panels 550 mm x 550 mm 8 items	[(0/90)] [+45/90/-45/0]$_s$ [(0/90)] fabric and tape or [(+45/-45)/(0/90)]$_s$ fabric	2.0÷2.5
Stiffened panel 1200 mm x 900 mm 1 item	[(0/90)] [+45/90/-45/0]$_s$ [(0/90)] fabric and tape or [(+45/-45)/(0/90)]$_s$ fabric	2.0÷2.5
Material type	Prepreg 977 - 2 34 24 k IMS - 194 - 300 (CYTEC) Or Dry Fiber: NCF (SAERTEX) = to locate the correct commercial name Resin: Resin 977 - 2 Hm - 328 - 35 (CYTEC)	

Subtask 1.2

Mechanical characterization of lamina and laminate used for both unstiffened and stiffened panels identified in Subtask 1.1: elastic moduli and stess/strain allowables according to the ASTM standards.

Characterization results have to be obtained by performing tests on proper coupons (according to the ASTM standards) manufactured at the same time together with the panels that have to be provided.

Moduli:

In-plane longitudinal, transverse and shear moduli (E_1, E_2, G_{12}, E_x, E_y, G_{xy})

Out-of-plane shear moduli (G_{23}, G_{yz})

In-plane Poisson's ratio (ν_{12}, ν_{xy})

Out-of-plane Poisson's ratio (ν_{23}, ν_{yz})

Density(ρ)

Strength:

Longitudinal and transverse tension and compression (X_{1t}, X_{1c}, Y_{1t}, Y_{1c})

Ply longitudinal shear (S°)

Subtask 1.3

NDE (X-radiographs) have to be carried out for each item specified in Subtask 1.1 in order to inspect any internal damages or defects due to manufacturing and cutting processes. Moreover, the actual dimensions should be compared to the nominal one as proof of production tolerances.

Subtask 1.4

Sensorisation of the panel including numerical optimisation of sensors/actuators number and locations (piezo-patches) by the mean of explicit finite element transient analysis simulations respecting the specifications provided within WP1.3.1 of the ITD (see ref. documents in 1.5 *Requirements*). Genetic algorithms should be considered as optimisation methodology and simulations should be developed within Ls/Dyna compatible finite element solver.

The minimum number of piezo-patches to be considered as sensor/actuator will be not less than 6 for each unstiffened panels and not less than 16 for the stiffened panel.

Task 2

a) Improvement of the POD-based damage detection technique for plate-like structures.
b) The enhanced version of the approach should be based on a damage index that may be calculated starting from the dynamic response of the damaged structure only.
c) The proposed enhanced POD-based damage detection technique has to be numerically tested on different 2D structural components test cases

1.5 Requirements:

Deliverable D 1.3.1-01/02: Material Specification Issued within the Deliverable “Application process Specification Issue and test plan configuration definition”

Deliverable D 1.3.1-03 “Application process Specification Issue and test plan configuration definition” to be issued.

A damage detection technique for plate-like structures based on Proper Orthogonal Decomposition (POD), JTI-GRA-WP 1.3.4 Internal Report

Preliminary assessment of a POD-based damage detection technique for plate-like structures, JTI-GRA-WP 1.3.4 Internal Report

1.6 Other

1.7 Schedule**, milestones and deliverables**

T0: July 1st, 2010

T0+3 (October 1st, 2010): Coupons (unstiffened panels) material characterization and NDE

T0+4 (November 1st, 2010): Stiffened panel, material characterization and NDE

T0+5 (December 1st, 2010) Sensors locations optimisations, including F.E. models in Ls/dyna format, numerical analysis output files, optimisation algorithm and results, as well as technical report with description of technical approaches.

T0+6 (January 15th,2011): Report on the improved POD-based damage detection technique

T0+7 (February 1th, 2011): Delivery of MATLAB code implementing the improved POD-based damage detection technique

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

Expertise in composite materials design, manufacturing and mechanical testing of advanced fiber composites.

Expertise in piezoelectric actuation and sensing system design and manufacturing.

Expertise in actuation/sensing optimization techniques with FEM modeling.

Expertise in the field of damage detection techniques based on Proper Orthogonal Decomposition; this has to be demonstrated through publications in international journals.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Unstiffened panels delivery	Hardware	T0+3
D2	Material characterisation and NDE of unstiffened panels	Technical report – experimental database and X-radiographs images of each panel	T0+3
D3	Stiffened panel delivery	Hardware	T0+4
D4	Material characterisation and NDE of stiffened panel	Technical report – experimental database and X-radiographs images of each panel	T0+4
D5	Sensors optimisation approach description including F.E. models (ls/dyna format), input and output analysis files, optimisation algorithms and technical description.	Technical report – input and output files in ls/dyna format – optimisation algorithm.	T0+5
D7	Improved POD-based damage detection technique; technical report	Technical report – Description of the improved methodology and discussion on the numerical tests performed to assess the new approach	T0+6
D8	Improved POD-based damage detection technique; code delivery	Software – MATLAB code performing the damage detection on plate-like structures based on the improved POD technique.	T0+7

4. Topic value (K€)

The total value of this work package shall not exceed:

120,000.--€

[One hundred twenty thousand euro]

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

5. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRA-01-028

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-01-028	Nano Modification of CFRP Resin	Start date	T0
		End date	*T0 + 12 months*

1. Topic Description

1.1 Introduction

1.1.1 Background: In task 1.3.5.1 nano-particles dispersion models and numerical simulation of interface properties will be applied (Virtual material design). Liquid resins will be characterised with respect to rheological and curing properties. Thermomechanical properties, strength and impact strength of samples containing no fibres and fibres will be measured. A correlation between the samples properties and composition / interface composition of the particles will be carried out.

1.1.2 Interfaces to ITD: The activity requires the nanoparticles selection, purification, modification/activation and dispersion into selected resin, the utilization of nanofilled resin in the production of a composite with a fibre reinforcement and finally the validation of properties improvement on the nano-reinforced resin (if the application is directly into the resin) and the innovative produced composite. The test phases will be at the coupon level on the nano-filled resin, the new composite and the simplified panels.

The test activity will characterize the materials and the structures both mechanically and functionally (conductivity test and FST properties):

- Nano-reinforced resins development

-Analysis and evaluation of base requirements coming from WP1.1

-Evaluation of data from past and current research

-Manufacturing process feasibility and definition

-Coupons

- Basic testing activity (chemical-physical, mechanical and specific for multifunctionality)

- Nano-reinforced composites technology development

-Analysis and evaluation of base requirements coming from WP1.1

-Evaluation of data from past and current research

-Manufacturing process feasibility and definition

- Coupons

- Basic testing activity (mechanical and specific for multifunctionality)

- Nano-reinforced subcomponents manufacturing for each material/technology selected
- Panels tests

1.2 Reference documents: not applicable

1.3 Scope of work: Preparation of master batches (5-50 wt-% of particles) of silica particles in two different epoxy resins. The particles must be ball shaped, not agglomerated and of uniform size.

• Variation of the particle size in the range between 10-50 nm.

• Preparation of master batches (5-50 wt-% particles) of elastomer particles in two different epoxy resins. The particles must be ball shape, not agglomerated and of uniform size as small as possible.

1.4 Type of work

Resin development. It is planed and agreed in this task to evaluate different properties which could be influenced by nano fillers. Cira+ works on the properties “Flame retardancy” and “Electrical conductivity”, Fraunhofer works on “mechanical strength” and “toughness”. Furthermore it is planed to evaluate the potential of blended modified resins to optimise all of the properties. Beside the know how about nano fillers, how to disperse them and stabilise the dispersions it is necessary to ensure the availability of nano modified resins in a commercial amount for the introduction in industrial manufacturing. For that it is necessary to cooperate with a commercial supplier. This commercial supplier should have experience in preparation of nano fillers and the production of stable nano modified dispersions.

1.5 Requirements : not applicable

1.6 Other : not applicable

1.7 Schedule**, milestones and deliverables**:

T0 assumed at June 2010

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

Long term experience in industrial manufacturing of nano filled dispersed resins (epoxy)

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.3.5-01.1	Technical report on material selection		T0 + 3 months
D1.3.5-01.2	Test report on mechanical and functional characterization of the nano-composite.		T0 + 12 months

4. Topic value (€)

The total value of this work package shall not exceed:

80,000.--€

[eighty thousand euro]

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

5. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRA-01-029

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-01-029	Definition of requirements and tests of practicability	Start date	*T0*
		End date	*T0 + 24 months*

1. Topic Description

***Short description**: In Task 1.3.6-02, adhesive joining technology is tailored for new composite materials to enable repair solutions based on adhesively bonded CFRP patches. The contribution of the partner looked for in this call for proposal will guarantee that the technological solutions will not only work under conditions of academic research, but will also work reliable if applied in commercial aircraft maintenance. This practical applicability of the technology will also be demonstrated in WP 1.3.7, representing the first demonstration phase of the project, where the partner shall perform repairs on test panels.*

1.1 Introduction

1.1.1 Background

In Task 1.3.6-02, adhesive joining technology is tailored for new composite materials to enable repair solutions based on adhesively bonded CFRP patches. This R&D work is performed by an GRA member. To ensure that the research results are applicable in aircraft maintenance, it is important to take care that the joining technology fulfils the specific requirements. The requirements have to cover factors like allowed adhesive and laminate material with the appropriate curing temperatures, the working environment which is given in aircraft overhaul and maintenace (e.g. hangars or workshops) as well as the skill level of workers. The contribution of the partner looked for in this call for proposal will guarantee that all relevant requirements will be considered, so that the technological solutions will not only work under conditions of academic research, but will also work reliable if applied in commercial aircraft maintenance. This practical applicability of the technology will also be demonstrated in WP 1.3.7, representing the first demonstration phase of the project, where repairs on test panels will be performed.

1.1.2 Interfaces to ITD

The CfP partner has solid experience concerning the bonded repair of composites according to the current state of the art. Consulting the partner, the ITD member will suggest modifications of the repair processes, e.g. a different surface pre-treatment, in WP 1.3.6. The CfP partner will deliver an assessment of the practicability of the modified processes and perform repairs on the level of coupon tests or small demonstrator components. The demonstrators will be delivered to the ITD member for mechanical testing. To contribute to WP 1.3.7, the CfP partner will perform repairs on larger demonstrator panels; this has probably to be done at the facilities of one of the ITD leaders.

1.2 Reference documents

none

1.3 Scope of work

The project concerns the evaluation of the performance of bonding strength and examination of practical application aspects of bonded composite repairs using innovative materials and, potentially, modified surface preparation processes. The examination of practical aspects should cover the whole range of repair application procedures, namely surface preparation of composite substrate (stepped / scarfed), lay-up of the repair patch, curing of the patch and the adhesive at elevated temperature (~120 °C) and NDI. Destructive testing of the repair demonstrators is not task of the CfP partner but will be performed by an GRA member.

1.4 Type of work

Manufacturing, testing, assessment of processes

1.5 Requirements

Two OEMs, Alenia and ATR, are partners directly involved in WP 1.3.6. The applicant is expected to supply a complementary point of view. For example, companies producing maintanance tools or specialized on performing repairs would be suited for this task.

Long term experience with aircraft maintanance is required. The applicant should possess state-of-the-art knowledge on composite repair technology and be experienced enough on real life composite repairs, in order to provide detailed remarks concerning practical problems that may arise from the new materials or processes and to propose potential solutions.

1.6 Other

1.7 Schedule**, milestones and deliverables**:

Since the work on this topic depends on the selection and modification of repair processes in WP 1.3.6 which in turn depends on the development of new composite materials, e.g. in WP 1.3.5, it is not possible to set a precise schedule yet. As a milestone, a first assessment of the bonded repair process for the new materials is expected at T0 + 9 months. The demonstrator repairs for WP 1.3.7 shall be performed at approximately T0 + 12 months. Schedule and contents of the deliverables are specified in section 3.

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

The applicant should be adequately equipped, in order to autonomously apply the specified repair procedures to coupons and components, which will then be tested by the ITD member in order to verify the strength of the bonding. Should advanced surface preparation methods be needed, then these will be done in cooperation with GRA member.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
1	Practicability of repair process	Report assessing the repair method for the new composite materials and pointing out potential for improvement	T0 + 24 months
2	Documentation of demonstrator repairs	Brief report documenting and illustrating the performed demonstrator repairs	T0 + 24 months

4. Topic value (K€)

The total value of this work package shall not exceed:

75,000.--€

[Seventy five thousand euro]

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

5. Remarks

The suggested maximum length of the proposal is 8 pages.

Topic Description

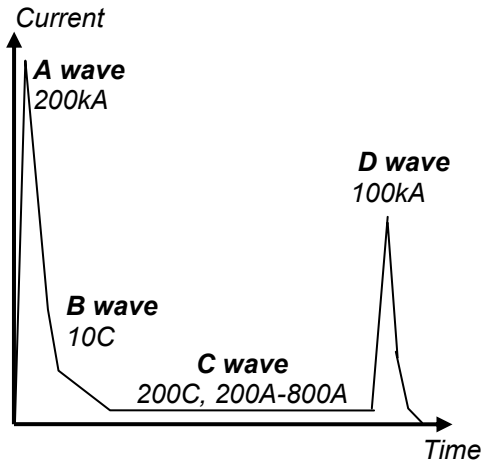
CfP topic number	Title		
JTI-CS-2010-1-GRA-01-030	Advanced Lightning tests on a few material types for aviation	End date	*T0 + 6*
		Start date	*T0*

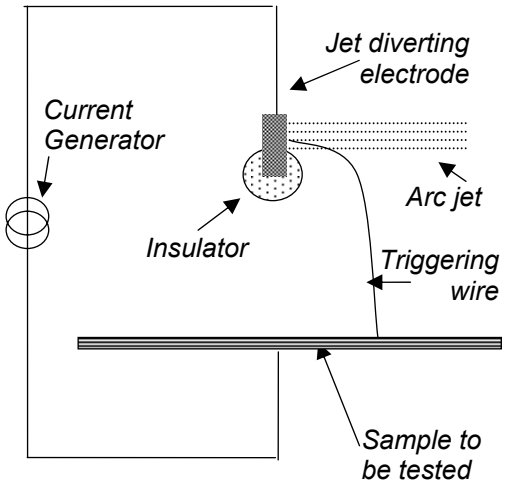
1. Topic Description

The aim of this work consists to perform lightning tests on new concepts of composite; in accordance with lightning certification process advised by regulation documents.These tests will be performed on three kinds of composite fuselages produced in the framework of JTI-GRA-LWC (Low weight configurations):

- Metallic wires interwoven composite (arc dispersion protection system)
- Nanoparticles reinforced composite (current conduction protection system)
- Integrated composites for wings and fuselage

The document ARP5412/ED84 advises the lightning current waveform that can be used for lightning tests (illustrated on left picture). In term of aircraft zoning, the element of fuselage is assumed to be located in 1A or 2A zone, which means that the samples have to be subjected respectively to A+B+C* or D+B+C* current waveforms. The document SAE ARP 5416 (section 5: hight current physical damages tests) advises aircraft lightning test method (illustrated on right picture).





The applicant must have at disposal:

- a current generator, able to produce A+B+C* and D+B+C* waveforms.
- a test facility compatible with the advised lightning test method
- special skills and equipments (see part 2)

Each type of material will be associated with single test campain. They will all start with preliminary tests in order to calibrate measurement equipments, and to characterize the specific lightning constraints of the material. These preliminary tests will be performed on aluminium panels that should provided by the candidate (see part 2). These tests also requires measurement system for the 2D deflection of the coupon. The sequence of test campain will depend on the availability of the material.

1. Description of the test campain on "Nanoparticles reinforced composite"

This test campain will consist to perform 25 preliminary tests on reference aluminium coupons (Ref. coupon) for mechanical constraint sizing, followed by 2 tests on two composite coupons. The tests n°1-5 and 16-20 consists to perform test on aluminium coupons. The tests 6-10 and 21-25 require *aluminium coupons pierced at the center. The tests 11-15 required two parallel rod electrodes.*

N°	***Material***	***Analysis***	***Waves***
1-2	*Ref. Coupon (2 tests)*	*Displacement (Frontal shock wave + magnetic)*	*D,B,C**
3-5	*Ref. Coupon (3 tests)*	*Displacement (Frontal shock wave + magnetic)*	*A,B,C**
6-7	*Ref. Coupon (2 tests)*	*Displacement (Frontal shock wave)*	*D,B,C**
8-10	*Ref. Coupon (3 tests)*	*Displacement (Frontal shock wave)*	*A,B,C**
11-12	*Ref. Coupon (2 tests)*	*Displacement (Radial shock wave)*	*D,B,C**
13-15	*Ref. Coupon (3 tests)*	*Displacement (Radial shock wave)*	*A,B,C**
16-17	*Ref. Coupon (2 tests)*	*Arc root measurements*	*D,B,C**
18-20	*Ref. Coupon (3 tests)*	*Arc root measurements*	*A,B,C**
21-22	*Ref. Coupon (2 tests)*	*Displacement (magnetic overpressure)*	*D,B,C**
23-25	*Ref. Coupon (3 tests)*	*Displacement (magnetic overpressure)*	*A,B,C**
26	*Comp. Coupon (1 test)*	*Direct effects damages*	*D,B,C**
27	*Comp. Coupon (1 test)*	*Direct effects damages*	*A,B,C**

2. Description of the test campain on "wires interwoven composite"

This test campain will consist to perform 25 preliminary tests to evaluate the effects of an arc dispersion protection system on the thermo mechanical constraint, followed by 5 tests on 5 composite coupons. Tests 1-5 do not require aluminium coupons. Tests 6-25 require aluminium coupons, on which the client will add specific coating.

N°	***Material***	***Analysis / characterization***	***Waves***
1-2	*Copper wire (2 tests)*	*Exploding wire shock wave*	*D,B,C**
3-5	*Copper wire (3 tests)*	*Exploding wire shock wave*	*A,B,C**
6-15	*Ref. Coupon (10 tests)*	*Displacement on coated coupon*	*D,B,C**
16-25	*Ref. Coupon (10 tests)*	*Displacement on coated coupon*	*A,B,C**
26-27	*Comp. coupons (2 tests)*	*Direct effects damages*	*D,B,C**
28-30	*Comp. coupons (3 tests)*	*Direct effects damages*	*A,B,C**

3. Description of the test campain on "*Integrated composites for wings and fuselage*"

This test campain will consist to perform 25 tests on alumium coupons in order to calibrate measurement equipments, followed by 5 tests on 5 integrated composites for wings and fuselage.

N°	***Material***	***Analysis / characterization***	***Waves***
1-15	*Copper wire (2 tests)*	*Direct effects damages*	*D,B,C**
16-25	*Copper wire (3 tests)*	*Direct effects damages*	*A,B,C**
26-27	*Comp. coupons (2 tests)*	*Direct effects damages*	*D,B,C**
28-30	*Comp. coupons (3 tests)*	*Direct effects damages*	*A,B,C**

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

The applicant must have at disposal the following equipments:

- Hight current test generator *able to produce A+B+C* and D+B+C* waveform (ARP5412/ED84).*
- A test facility compatible with the advised lightning test method (*SAE ARP 5416*) and the client conditions (for example, the use of two parallel rod electrodes).
- 75 prepared aluminium panels (Ref. coupon) of at least 400x400x2 mm for preliminary tests and calibration, on which the client will add its specific coating
- The hole diameter located at the center of the panel (tests 6-10 and 21-25 of test campain 1) must be greater than the rod diameter by 1mm.
- Electric measurements (current, voltage)
- Measurements of 2D deflection of the coupon (temporal resolution from 10µs to 100µs).
- Evalutation of the arc root displacements properties with two fast video cameras (10000 fps)
- Other equipments for hight current tests (Faraday cage, synchronisation system …)

The applicant have to describe precisely:

- Its test facility (current generator, electrodes…)
- Its equipements / requirements (specifications of instruments, cameras, aluminium coupons …)
- How the instruments (spectrometer,…) of the client could be integrated in the test facility (trigger, shelter, available mechanical interface,…)

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Detailed plan of the lightning test campaign		T0 + 1
D2	75 aluminium panels		T0 + 2
D3	Lightning test report		T0 + 6

4. Topic value (K€)

The total value of 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 programme

5. Remarks

This advanced lightning test campaign is focused on a detailed analysis of the mechanisms that produces the damages on the new concepts of composite. As a result, the *duration* of each test campaigns will need to be about 10 days:

- 6 days for the preliminary tests
- 4 days for the tests of new concepts of composite

Total duration of all of the tests should be 1 month.

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRA-01-031

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-01-031	Functional laminates development. Components compatibility and feasibility assessment. Industrialization	**Start date**	*T0*
		End date	*T0+27*

1. Topic Description

***Short description**: The subject of this CfP is to higlight activities to be performed on CFRP laminated structures, where a combination of different materials and manufacturing techniques will be used to provide advanced laminates concepts to improve baseline functionality. Feasibility of effective industrialization of proposed hybrid composite laminates will be covered.*

1.1 Introduction

1.1.1 Background: EADS-CASA is involved in developing multifunctional laminates with a practical application to the forward part of the GRA fuselage. In this context, current job would be complemented with results of this call.

Activity schedule foresees about 18 months of development plus another 9 months regarding industrialization aspects and focuses mainly laminate improvement in following characteristics: Acoustic, Erosion, Lighting protection (including electrical conductivity) and Impact damage tolerance, trying to maintain mechanical properties of nominal CFR baseline structure.

1.1.2 Interfaces to ITD: The activities being carried on against this proposal fit into WP1.3.3 EADS-CASA involvement and it is foreseen being monitored through appropriate documentation, production of specimens and settlement and verification of test results plus correspondent manufacturing trials as it become required. The information exchange moreover that through correspondent deliverables, will be at specific meetings or video conferences being called by ITD along the proposed period (4 times/year). Final acceptance of materials and manufacturing process will be approved by ITD.

1.2 Reference documents

Not applicable

1.3 Scope of work:

1.- Selection of material candidates (elastomer or similar) for laminate integration with acoustic damping charateristics

2.- Structural properties of selected material acounting for anti-erosion characteristics for external aplication

3.- Elastomer treatment (interface) to be embedded in the composite structure (laminate and sandwich)

4.- Manufacturing trade-offs for material selection

5.- Manufacturing consolidation through plain laminates and honey-comb panels with elastomer layers in conjuction with lighting strike protection mesh

6.- Evaluation of mechanical characteristics of manufacturing trials through a set of nominal testing for basic properties comparison

7.- Evaluation of acoustic transmisibility and structural damping characteristics of manufactured configuration relative to correspondent baseline structural concepts

8.- Evaluation of lightning strike direct effect protection to evaluate damages on CFRP structures where acoustic and metallization materials has been combined

9.- Evaluation of moisture ingress protection, since the use of elastomers will be an improvement, specially for sandwich constructions

10.- Damage growth assessment and involved material properties

1.4 Type of work: The work deals mainly with consultancy, manufacturing and testing (including NDI).

Main Tasks:

a- Identification of feasible materials and selection of candidates (at least two). Materials properties usefull for the structural aplication being studied should be provided jointly during selection (i.e. for elastomeric matarials dependence of mechanical properties with respect to temperature and frequency –nomogram or master curve)

b- Manufacturing trade-offs for several laminates conceptual approaches. Assessment of compatibility for various temparature and moisture conditions supported by test evidence.

- Plain laminate feasibility coupons (at least two types of elastomer) to validate metallic mesh and painting interface
- Sandwich feasibility coupons (two types of core / two types of elastomer)

c- Evaluation of anti-erosion characteristics for external aplications

Blast testing with different erosive materials and energies (sand & hail and water drops)

d- Manufacturing trials for mechanical evaluation

A set of coupons will be extracted from manufacturing trials to evaluate structural properties described in paragraph (h) of current task list. In this context, several panels will be manufactured for different configurations to enable at least sets of 10 coupons for each characteristic being compared. Following configurations are foreseen for costs evaluation purposes:

-Conf 1: Basic CFRP w/o additional protection materials, solid laminate, 3 mm thick
-Conf 2: Basic CFRP with an additional layer of protection material (one or two layers) in a solid laminate. 3 mm thick
-Conf 3: Basic sandwich panel 3plies+ 15mm core + 2plies
-Conf 4: Basic sandwich panel with an external layer of protection material
-Conf 5: Basic sandwich panel with an internal layer of protection material
-Conf 6: Basic in a sandwich panel with an external and internal layers of protection material

Bearing in mind the size of foreseen coupons and the number of specimens needed to accomplish statistics requirements, one flat 1000 x 500 mm panel per configuration is foreseen being manufactured

e- Manufacturing trials for lightning direct effect protection evaluation

A set of coupons will be extracted from manufacturing trials to evaluate lighting protection. Size of coupons and others detail will be fixed in the appropriate Request for Test corresponding to the following configurations:

-Conf 1 with external (TBD) metallization
-Conf 2 with external (TBD) metallization (two off) x (2) for metallization alternatives
-Conf 3 with external (TBD) metallization
-Conf 4 with external (TBD) metallization (two off) x (2) for metallization alternatives

In order to estimate the cost, panels of 1000 x 500 mm size should be considered.

f- Manufacturing trials for acoustic and vibrational evaluation

A set of pannels with a minimum dimention to enable testing in double chamber for a frequency range 0 – 4Khz will be produced to get dynamic characteristics at specific ranges.

- Conf 1
- Conf 2 (Two off) x(2) for metallization alternatives
- Conf 1 with stiffeners TBD
- Conf 2 with stiffneres TBD
- Conf 3
- Conf 4 (Two off)x(2) for metallization alternatives
- Conf 5
- Conf 6 (optimized for acoustic depending on previous results)

Metallization aspects will be based on lightning protection guidelines. Assessment of the elastomer location and topography on the samples shall be performed for maximum noise and vibration damping efficiency.

In order to estimate the cost, panels of 1000 x 500 mm size should be considered

g- Manufacturing trials for moisture ingress evaluation

A set of coupons will be extracted from manufacturing trials to evaluate lighting protection. Size of coupons and others detail will be fixed in the appropriate Request for Test corresponding to the following configurations

- Conf 3
- Conf 5 (two off)

In order to estimate the cost, panels of 500 x 500 mm size should be considered

h- Moisture ingress evaluation

-Water inmersion according to appropriate Request for Test

i- Lightning and inspection tests

- Direct ligthning attachment at zone 1A (200KA, 2x 10^6 A^2s) and Zone 2A(100KA, 0.5x 10^6 A^2s) threat
- NDT inspection of tested samples shall be carried out to evaluate damages

j- Mechanical tests

Following properties will be evaluated and compared with the basic standard flat sandwich and solid laminate panels properties:

- Damage due to a low energy impact: area of the damage, identation and depth of the damage and basic properties from wich damage growth might depend on
- Compression after impact strength at RT/AR and H/W test conditions
- Tension after impact strength at RT/AR and H/W test conditions
- Flat wise tensile strength for sandwich panels
- Interlaminar shear strength for solid laminate

k- Acoustic and vibration tests

The different panels manufactured for such a purpose will be tested to meassure:

- Acoustic Transmission Loss (TL) for acoustic noise between 125 Hz and 4 KHz
- Structural dynamic response accounting for appropriate means for structural excitation and vibration measurement for frequency range between 0 to 2 KHz.
- Optionally, if it becomes feasible, radiated noise measurement

if applicable, state the type of work required: ex. Analysis, Modelling; design; development; simulation; testing; manufacturing, etc

l- Industrialization

As results of the trade off and the rest of manufacturing trials to produce requested panels, additional trials must be done to show the difficulties involving automatic process. Curved panels manufacturing should be evaluated through FP. Reliability of manufactured specimens will be probed through NDI including water ingress and mechanical checks through travellers/coupons testing.

d) **1.5 Requirements** :

Requests for test to be issued by ITD

e) **1.6 Others** :

Non applicable

1.7 Schedule**, milestones and deliverables**:

Tasks a, b & c have to be completed by T0+04

Tasks d to h have to be completed by T0+11

Tasks i must be completed by T0+15

Tasks j must be partially finished by T0+15 for RT and completed by T0+20 for H/W specimens.

Tasks k must be completed by T0+18

Tasks l foreseen completed T0+27

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

- Experience in selection of materials (elastomers or similar) and treatment for integration into laminates
- Experience in manufacturing laminates both hand and automatic lay-ups
- Experience in coupons preparation for mechanical testing
- Experience in mechanical evaluation of CFPR aeronautical structures.
- Experience in acoustic and vibration testing of panels and assessment of tets results.
- Experience in lighting strike test

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.3.3-01	Acoustic material selection. Properties	Document	T0+02
D1.3.3-02	Feasibility assessment	Samples+ NDI+ Report	T0+04
D1.3.3-03	Panels design and manufacturing	Samples+ NDI+ Report	T0+11
D1.3.3-04	Coupons manufacturing	Samples+ NDI+ Report	T0+08
D1.3.3-05	Erosion assessment	Document	T0+11
D1.3.3-06	Moisture ingress test results	Document	T0+11
D1.3.3-07	Lightning strike test results	Document	T0+15
D1.3.3-08	Mechanical test results for RT/AR	Document	T0+15
D1.3.3-09	Mechanical test results for H/W	Document	T0+20
D1.3.3-10	Acoustic test results	Document	T0+18
D1.3.7-01	Industrialization proposal	Document	T0+18
D1.3.7-02	Manufacturing trials flat	Samples +NDI+ Report	T0+22
D1.3.7-03	Manufacturing trials curved	Samples +NDI+ Report	T0+27

4. Topic value (K€)

The total value of 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 programme

5. Remarks

The meetings for project monitoring will be held at EADS-CASA plants in Getafe. Foreseen a meeting every three months.

Acoustic and vibration tests should be done using maximum communalities for all panels to optimize subsidiary costs and speed up testing for the whole set of specimens.

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRA-01-032

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-01-032	Resin, Laminate and Industrial Nanoparticles Concept and Application. Industrialization	**Start date**	*T0*
		End date	*T0+27*

1. Topic Description

***Short description**:*

The subject of this CfP is to develop new procceses and technique to improve mechanical, electrical and thermal properties of CFRP laminates by means of adding nanoparticles into the carbon fibre itseft and into the epoxy resin matrix to obtain a fully nanoparticle filled material to be used in laminated specimens.

1.1 Introduction

This work is allocated inside the WP 1.3.5 which is devoted to the development of nanoparticles reinforced carbon fibre aeronautical structures to improve their mechanical and electrical characteristics with objective to reduce weight with respect to classic laminates.

Currently several works about carbon nanotubes (CNT) deposition on epoxy resin are proposed in the WP 1.3.5, the proposed tasks herein are aiming at producing fully loaded laminates.

1.2 Reference documents

None

1.3 Scope of work :

The objective of this topic is divided into tree main activities:

a- Development of processes and techniques, to deposit carbon nanotubes and other nanoparticles, in a homogenous manner into the epoxy resin. Evaluation of a stable and good dispersion is a goal in this subject, as well as the feasibility of automation of the process.

b- Development of processes and techniques, to produce polymer microfibres with carbon nanotubes and other nanoparticles homogenous loading. PAN (polyacrylo nitrile) and other carbon fibre precursors shall be used.

c- Graphitization of CNT loaded PAN microfibres to be able to prepare a single directional tape. This tape shall be suitable to produce a basic prepreg material with the CNT loaded epoxy resin of the previous activity to manufacture samples for mechanical, electrical and thermal testing.

1.4 Type of work:

- Preparation of nanoparticles loaded compounds. Evaluation of the proposed dispersion method for the stability and dispersion point of view.

- Rheological, morphological and Spectroscopic studies of the loaded materials shall be carried out to evaluate the effects on the base material properties.

- Preparation of laminate samples (5 coupons 500x500mm) and evaluation of electrical and thermal conductivity characteristics.

- Evaluation of laminate samples (5 coupons 500x500mm) against conducted lightning current pulses. ARP5412/ED84 shall be used to define current waveforms.

- Preparation of laminate samples (10 coupons 500x500mm) and evaluation of mechanical properties (CAI, TAI, ILSS and fracture behavior shall be considered).

1.5 Requirements :
The method of nanoparticles dispersion and microfibres production shall be described.
A description of the facilities to be used to develop the different materials shall be provided.
The testing methods for the various evaluation shall be proposed.

1.7 Schedule**, milestones and deliverables**:
- Selection of nanoparticles and other materials: T0+05
- Dispersion in epoxy resin and properties characterization: T0+09
- Resin evaluation report (D1): T0+11
- Processes for polymer microfibres: T0+09
- Production of CNT filled polymer microfibres and graphitization: T0+15
- Precursor evaluation and microfibres production report (D2): T0+16
- Prepreg tape manufacturing: T0+18
- Laminate coupons manufacturing: T0+19
- Conductivity testing. Test report (D3): T0+20
- Mechanical testing. Test report (D4): T0+25
- Industrialization Studies report (D5): T0+27

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

Experience in nanoparticles dispersion is a must in this topic.

Experience on rehologic and Raman spectroscopic evaluation.
Experience in structural evaluation of aeronautical CFPR laminates.
Availability of testing facilities needed forn this project shall be shown.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Resin loading process and evaluation	Document	T0+11
D2	Precursor polymer loading process and evaluation	Document	T0+16
D3	Thermal and electrical conductivity test results	Document	T0+20
D4	Mechanical evaluation report	Document	T0+25
D5	Industrialization report	Document	T0+27

4. Topic value (K€)

The total value of this work package shall not exceed:

180,000.--€

[one hundred eighty thousand euro]

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

5. Remarks

The meetings for project monitoring will be held at EADS-CASA installations in Getafe. Meetings are foreseen every three months.

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRA-01-033

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-01-033	Trade-off study for the ranking of new technologies best fitting wing	**Start date***	*T0*
		End date**	*T0+5(M)*

1. Topic Description

***Short description**:*

The CfP requires the development of a trade-off study, to be conducted on the basis of Finite Element model simulations, between a reference wing stub box design, developed in a previus phase of the WP, and advanced designs of the same structure incorporating new trechnologies selected among the ones developped within WP 1.3. The study will help to define the structural solution for the wing proof test articles to be tested in WP 1.3.7.

1.1 Introduction

1.1.1 Background

The CfP will cover applied research activities that are part of WP 1.4.1, titled “Ranking of applicable technologies”, of the Low Weight Configuration Domain (GRA1). WP 1.4.1 is dedicated to design studies finalized on the application of the enabling technologies, developed in WP 1.3, to the structure of a typical regional aircraft.

Within WP 1.4.1, an GRA member collaborates to task T1.4.1-02 (Analysis of technologies best fitting wing) whose activities are focused on the wing structure.

This member contributions are organized into three sub-tasks:

Subtask 1	Definition of the configurations and the manufacturing processes of the main structural elements of the wing of a generic future regional aircraft using selected technologies.
Subtask 2	Definition of a reference wing stub box sized considering the traditional materials and technologies addressing weight, manufacturing and maintainability issues.
Subtask 3	Development of a trade-off study to select the configuration and technologies best fitting wing and compliant with the requirements established in WP 1.1.

The CfP will cover most of the activities to be performed in subtask 3. The selected applicant will operate in close collaboration with the CfP proponent.

1.1.2 Interfaces to ITD:

The work to be developed by the applicant will be based on the results of activities carried out by the CfP proponent within WP 1.4.1 and on inputs coming from all the partners involved in the development of WP 1.3. In particular the CfP activities will depend on the availability of inputs and deliverables from WP 1.3.1, 1.3.2, 1.3.3, 1.3.5 and 1.3.8. To diminish the criticality of such dependency, the CfP proponent shall decide to start the activities on the basis of reasonable engineering assumptions, if some of the inputs will be eventually missing.

The inputs to the applicant will be handled by the CfP proponent and will consist in technical report and geometrical models. Geometrical models data will be exchanged using the CATIA V5 (Rel.18) native format (preferred) or neutral .igs format.

The outputs of the activities developed by the applicant will consist in FE models and technical reports. FE models and sub-models will be delivered in terms of analysis input files for both NASTRAN (MSC 2005r2) and ABAQUS (Standard/Explicit 6.9) solvers.

1.2 Reference documents

Not applicable.

1.3 Scope of work:

A trade-off study, between a reference wing stub box design and advanced designs (incorporating new technologies) of the same structure, is required. The study will be conducted on the basis of Finite Element model simulations. The new technologies to be used will be selected by the CfP proponent, among the ones developed within WP 1.3, in a previous phase of the WP (T1.4.1-02.1). The design results relevant to a reference wing stub box, developed by CfP proponent in T1.4.1-02.2, will be suppplied to the selected applicant for the necessary comparisons.

The applicant must develop a number of FE models of the wing stub box considering different structural solutions, to be agreed upon with the proponent, and incorporating a defined set of the preselected new technologies. As a reference the models will consider different structural configurations for the spars (2 configurations), the ribs (2 configurations) and the outer skin panels (3 configurations). Each of the models must be representative of an equally refined design (comparable levels of Safety Margins) and must incorporate adequate structural details (component interfaces, openings, fittings and local reinforcements). Each of the configurations may generate model sub-variants (2 maximum) depending on the material/layer/multilayer technology selected or on the repair concept adopted for the outer panels. For key components (i.e. spars, ribs and panels), the design and the models may require adequate interfaces, for the sensors and equipments of a SHM system which will be considered to be active in realizing a continuous health monitoring of the structure.

All the analyses will consider a given set of relevant static load cases. The comparison of the performances of the different solutions will be carried out in terms of weight, strength, and stiffness and buckling behaviour.

The trade-off study will help to define the structural solution for the wing proof test articles to be tested in WP 1.3.7.

The activities foreseen would include the following phases:

Phase 1: Development of a baseline model of the advanced wing box stub

A FEM model of a baseline configuration of the wing stub box will developed and analysed under the given load cases. The results will be evaluated with respect to the relevant figures of merit (weight, strength...) and the design will be modified to reach an agreed (with the CfP proponent) level of refinement.

Input: basic master surfaces, technical reports from WP1.4.1 subtask1, inputs from WP 1.3

Output: Deliverable D1 (see section 3 for details)

Phase 2: Development of analyses with models variants

FEM models of all the configurations of the wing stub box will developed and analysed under the given load cases. The results will be evaluated with respect to the relevant figures of merit (weight, strength,) and the design will be modified to reach a level of refinement comparable with the baseline configuration (comparable levels of Safety Margins).

Input: same as phase 1, results of phase 1

Output: Deliverable D2 (see section 3 for details)

Phase 3: Development of refined models and analyses

The trade-off study will be finalized comparing the different variants of the design in terms of the agreed figures of merit. The CfP proponent will select the most promising solutions of the wing stub box for which designs of some structural details will be developed.

FEM models of such structural details will developed and analysed under the given load cases. The results will be evaluated with respect to the relevant figures of merit (weight, strength, production and maintenance).

Input: same as phase 1, results of phase 1 and 2

Output: Deliverable D3 (see section 3 for details)

1.4 Type of work:

The applicant work will consist in the development of Finite element models of a wing stub box. The geometry will be referenced to given basic master surfaces and will be agreed with the CfP manager for each model. The applicant will carry out static analyses on the models and compare the results of the different design variants.

1.5 Requirements:

Although the applicant is free to select the most appropriate computational tools to carry out the trade off study, FE models and sub-models are required to be compatible with both NASTRAN (MSC 2005r2) and ABAQUS (Standard/Explicit 6.9) solvers.

1.6 Other:

Not applicable.

1.7 Schedule**, milestones and meetings**:

A kick-off meeting (KOM), two progress meeting (PM) and a final meeting (FM) will be scheduled at the topic manager site. They will coincide with critical milestones (M). The activities will be developed as defined by the following schedule:

Time	meeting	milestone	Description
T0	KOM		Definition of the detailed work program
T0+1	PM1	M1	Baseline model of the advanced wing box stub completed
T0+4	PM2	M2	Analyses with models variants completed
T0+5	FM1	M3	Trade-off and analyses on details completed

The expected maximum length of the proposal should be 12 pages.

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

Due to the short duration of the activities, the proposal should address clear indications of the resources, in terms of personnel, simulation software and computational power, the applicant will use to carry out the work.

The applicant is expected to have experience in FE modelling and simulation of composite aerospace structures

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Baseline FE model and analysis report of the advanced wing box stub	The deliverable comprises: • the FE model of the wing box • sub-models of relevant components or parts (to be defined) • report documenting model features and analyses results	T0+1
D2	FE models and analysis report of all the design variants	The deliverable comprises: • the FE model of all the design variants of the wing box • sub-models of relevant components or parts (to be defined) • report documenting model features and analyses results	T0+4
D3	Refined FE models and trade-off report	The deliverable comprises: • FE models of the relevant structural details • report documenting analyses results • report documenting the trade-off results	T0+5

4. Topic value (K€)

The total value of this work package shall not exceed:

120,000.--€

[one hundred twenty thousand euro]

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

5. Remarks

(*) The start date (T0) might be adjusted according to the status of the activities of WP 1.4.1 and/or to the availability of inputs from other WPs.

(**) A reference duration of 5 months is foreseen, nevertheless a modest increase, up to a maximum of 6 weeks, might be negotiable if status of WP 1.4.1 would permit.

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRA-02-007

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-02-007	Wing/pylon/nacelle/HLD for advanced Regional Turbo-Fan A/C configuration by multi-disciplinary design with aero-elastic constraints	Start date	T_0 foreseen 01/07/2010
		End date	T_0 + 10 months

1. Topic Description

Short description

Aerodynamic optimisation, aero-elastic modelling/preliminary structural lay-out and HLD conceptual design of a wing configuration with engine-nacelle installed, tailored to top-level requirements and general architecture of a next-generation Turbo-Fan Green Regional Aircraft (cruise Mach = 0.78).

1.1 Introduction

1.1.1 Background

Within the “Low-Noise Configuration” (LNC) Project of the Green Regional Aircraft ITD advanced wing technologies are addressed tailored to future regional airliners, by taking into account several A/C configurations and different power plant architectures. The final aim is to contribute to drastically reduce the environmental impact of regional air transport over next decades, according to the strategic road map stated in the “Vision 2020” by ACARE.

On this scenario, technology innovation will be pursued along the LNC project work programme toward paramount concepts/functions for a next-generation Green Turbo-Fan Regional A/C configuration:

i) HLD low-airframe noise solutions at approach/landing phases to reduce the annoyance perceived by the resident population in the neighbourhood of airports;

ii) Highly-efficient aerodynamics to reduce fuel consumption and pollution at cruising flight condition;

iii) Loads control to enhance aerodynamic efficiency in all flight phases, so as to reduce fuel consumption and gaseous emissions over the whole mission profile and allow steeper, noise-abatement take-off/ initial climbing trajectories;

iv) Loads alleviation to avoid any possible loads exceeding over structural design point so as to optimise the wing structural design for A/C weight savings.

1.1.2 Interfaces to ITD

The work being the subject of the present CfP is concerned with a multi-disciplinary design (aerodynamics, loads, aero-elasticity, structures, systems) and optimisation of wing/pylon/nacelle/HLD geometry, as baseline configuration for further technology studies planned within the LNC project tailored to a Green Regional Turbo-Fan A/C platform.

The input/output geometrical models data exchange will be handled through standard formats (IGES, CATIA, NASTRAN).

1.2 Scope of work

Topics and expected outcomes of the activity inherent to the present Call for Proposals are dealing with:

i) Conceptual multi-disciplinary design, coupling CFD based aerodynamic optimisation and aero-elastic modelling/preliminary structural layout, of a transonic wing (cruise Mach = 0.78) with engine-nacelle under wing installation for a future Turbo-Fan Regional A/C configuration;

ii) Conceptual, CFD based, aerodynamic design of relevant HLD architecture and preliminary lay-out of respective deployment mechanism and actuation system.

The wing/pylon/nacelle/HLD conceptual design achieved through this activity will be the baseline geometry for the further technology development phase planned within the LNC project, dealing with

low-noise HLD solutions and wing loads control/alleviation concepts suitable for future applications to a green Turbo-Fan Regional A/C configuration.

1.3 Type of work

Aerodynamic (CFD) analysis & design; structural (FEM) modelling; structural/aero-mechanics analysis (aerodynamic and loads) and structural lay-out optimisation; static/dynamic aero-elastic analyses, HLD kinematics modelling and dynamic simulations.

1.4 Abbreviations & Definitions

A/C	Aircraft
ACARE	Advisory Council for Aerospace in Europe
AoA	Angle of attack
CAD	Computer Aid Design
CFD	Computational Fluid Dynamics
C_D	Drag coefficient
C_L	Lift coefficient
C_m	Pitching moment coefficient
D	Drag
FEM	Finite Element Model
HLD	High-Lift Devices
L	Lift
LE	Leading Edge
LNC	Low-Noise Configuration
Mach	Mach number
MDO	Multi-Disciplinary Optimisation
TE	Trailing Edge
2D	Two-Dimensional
3D	Three-Dimensional

Note:

Aerodynamic coefficients refer to the wing-fuselage-pylon-nacelle geometry (cruise configuration) plus HLD (high-lift configuration).

1.5 Description of Work

According to the objectives described in par. 1.2, the concerned activity will develop through several tasks as described hereinafter.

1.5.1 Task1 – Wing Aerodynamic Design

The first phase of the required work will be dealing with a CFD based 3D aerodynamic optimisation of the wing at transonic cruise design point (C_L, Mach), by taking into account the effects on the flow field of the under-wing nacelle/pylon installation. Relevant numerical analyses will have to be carried out by also considering the presence of the fuselage, so that the complete configuration to be studied at high-speed (cruise) condition (Mach = 0.78) will be a wing-fuselage-pylon-nacelle geometry.

Fuselage and pylon-nacelle configurations will be provided in input. The fuselage geometry will be not modified. Changes in the nacelle/pylon initial configuration and installation (relative position to the wing and shape modifications) are not strictly requested to be considered in the design phase. However, taking them into consideration during the proposed optimisation work would become a key factor of selection in the evaluation process of applicants' proposals.

Inputs:

a) Fuselage, pylon + nacelle geometry (CAD model);

b) Geometrical parameters to define the (initial) span wise and longitudinal location of the pylon/nacelle under-wing installation;

c) Cruise design conditions (altitude, C_L, Mach);

d) Aerodynamic efficiency (L/D) target at cruise design point;

e) Geometrical constraints: minimum wing internal volume for fuel tank, spars positions, minimum wing thickness at given span wise and chord wise locations, etc.

f) Aerodynamic constraints:
(AoA, Cm) at cruise design point; buffet limit; $C_{L\,max}$ at low-speed (Mach ≈ 0.2).

Wing design variables: sweep angle, camber, twist distribution, thickness distribution.

Other optional design variables could be related to the pylon/nacelle geometry and their installation relative to the wing (see above).

Outputs:

a) 3D geometry (CAD model) of the wing/pylon/nacelle optimised configuration (**deliverable D1**);

b) Aerodynamic performance assessment of the wing/pylon/nacelle optimised configuration at transonic cruise, low speed ($C_{L\,max}$, stall path) and off-design conditions (**deliverable D2**). Relevant data, from CFD analyses results, will have to include: i) global aerodynamic coefficients (C_L, C_D, C_m); ii) pressure and Mach number distributions; iii) aerodynamic mesh (NASTRAN bulk data format); iv) stability and control derivatives.

1.5.2 Task 2 – Wing Aero-elastic Design

Starting from the wing aerodynamic design (Task 1), the second phase of the activity will be an MDO process involving aerodynamics (CFD), weights, static/dynamic loads and aero-elasticity to optimise the wing box structural lay-out (supposed to be made of composite material) for selected design points in order to minimise weight and to have no criticality in terms of divergence and flutter, while preserving the wing aerodynamic efficiency at cruise condition. In doing so, the mass effects of the leading edge and trailing edge portions of the wing (ahead the front spar and behind the rear spar, respectively), of the pylon-nacelle bodies and of the allowable fuel will have to be taken also into account. The total structural weight of the wing derived from the concerned optimisation should be compared to the weight of geometrically similar wing metallic architectures of existing aircraft.

Inputs:

i) Wing geometry as derived from the aerodynamic design (Task 1);

ii) Wing spars positions, etc.

The concerned activity should be developed along the following steps:

1) Preliminary definition of wing box FEM based on several assumptions in terms of initial dimensions of different elements (spars top & bottom flanges/web/ribs, upper & lower skin, stringers, etc.) and of relevant composite materials properties;
2) Definition of aerodynamic loads conditions (from CFD analyses) at selected design points;
3) Static optimisation (verification of allowable stress/strength, buckling analysis);
   Variables: thickness of spars, ribs, skin, etc.
   Target: weight minimisation
4) Modal analyses at different fuel mass conditions and static/dynamic aero-elastic analyses (divergence, flutter);
5) Aerodynamic performance assessment (through CFD analyses) to verify that the wing external shape aero-elastic deformation does not exceed certain limits (e.g. wing tip torsion) and, hence, does not deteriorate beyond an acceptable value the aerodynamic performance of the optimal wing design achieved in previous Task 1.

Steps 4 and 5 will take place in a closed loop with step 3 above.

Outputs:

a) Optimised (robustness, stiffness) FEM (NASTRAN model) of wing box under structural and aerodynamic performance constraints (**deliverable D3**);

b) Structural and aero-elastic assessment of the wing box model (**deliverable D4**). Relevant data will have to include: i) structural weight of the optimised wing box; ii) wing box allowable fuel tank volume; iii) structural dynamic analysis results (normal modes) for different (empty and full tank) mass fuel conditions; iv) aero-elasticity analysis results (divergence and flutter); v) aerodynamic and inertial loads distributions or envelope (integrated forces and moments) on specific wing span wise points at selected loads design conditions.

1.5.3 Task 3 – HLD Aerodynamic Design

CFD based aerodynamic design of the HLD architecture tailored to the wing geometry designed in Task 1. This activity will be likely implying the definition of a conventional 3-element wing high-lift configuration (LE slat, main-element, TE single-slotted flap) to meet the relevant $C_{L\ max}$ target at approach condition. Pending on the aforementioned high-lift requirement, however, the necessity to consider more complex HLD solutions (e.g. LE slat combined with a double-slotted TE flap system) cannot be excluded a priori. In any case it is mandatory, for the purpose of the low-noise technologies studies foreseen in the LNC project, to consider HLD concepts with a conventional LE slat device. This task, once the wing aerodynamic design (cruise shaping) is defined (Task 1), might proceed in parallel with Task 2 above.

The concerned activity is expected (suggested) to be developed along two steps as described below. The proposed approach relies on the assumptions of well-known empirical transposition formulae from 2D to 3D cases and vice versa.

i) HLD 2D design through CFD based aerodynamic optimisation of the multi-element airfoil geometry, trying to meet the $C_{L\ max}$ target.

ii) 3D CFD analyses to assess (verify) the relevant high-lift performance ($C_{L\ max}$) of the wing/fuselage/pylon/nacelle/HLD configuration at take-off/first climbing and approach conditions.

Inputs:

a) Wing geometry as derived from the aerodynamic design (Task 1);

b) Design point (altitude, Mach) at take-off/first climbing and approach conditions;

c) Aerodynamic target ($C_{L\ max}$) at design points;

c) Geometrical constraints (front and rear spar positions, TE flap span wise extent, etc.)

Design Variables: types and shape of multi-element HLD concepts, in any case including a conventional LE slat (see above).

Outputs:

a) 3D geometry (CAD model) of the wing multi-element high-lift configuration (**deliverable D5**);

b) Aerodynamic assessment of the wing/fuselage/pylon/nacelle/HLD configuration at take-off/first climbing and approach conditions **(deliverable D6**). Relevant data will have to include: i) global aerodynamic coefficients (C_L, C_D, C_m); ii) pressure distributions at given span wise stations.

1.5.4 HLD kinematics design

Conceptual design of deployment mechanism of the HLD architecture developed in Task 3. The aim is to verify that the proposed optimised HLD settings, derived from the aerodynamic design, are compliant with feasible solutions of the relevant kinematic device (tracks, joints, etc.) and to provide preliminary requirements of the relevant actuation system.

Inputs:

a) HLD aerodynamic design (from Task 3);

b) Aerodynamic loads acting on the HLD components (from Task 3).

Outputs (**deliverable D7**):

a) Lay-out of HLD deployment device;

b) Aerodynamic loads acting on the structural components of the HLD deployment mechanism (joints, hinges) and definition of preliminary requirements (i.e. actuators sizing) of the relevant actuation system.

1.6 Requirements

Sensitive information may be released at a later date to the successful applicant.

1.7 Milestones

M1 (T_0 + 5 months):
Release of Wing/pylon/nacelle optimised geometry (cruise configuration) – CAD model (deliv. D1)

M2 (T_0 + 8 months):
Release of Wing/pylon/nacelle/HLD architecture – CAD model (deliverable D5)

M3 (T_0 + 9 months)
Release of the wing box optimised aero-elastic FEM model (deliverable D3)

M4 (T_0 + 10 months)
Release of the HLD deployment system lay-out

Review meetings to monitor on the work progress will be scheduled likely two weeks before the expected achievement of respective milestones above. On such occasions, recovery actions will be decided, in case of delayed activities, trying to stay in the overall initial planning.

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

Due the technical complexity of the requested activity and the relevant tight schedule, the proved expertise of the applicants in the concerned multi-disciplinary technological fields will be a key factor of selection.

The use of advanced computational tools for aerodynamic and aero-elastic/structural analyses is regarded as a paramount requirement to correctly address the physical phenomena involved.

3. Major deliverables and schedule – T_0 (currently foreseen): July 2010

Deliverable	Title	Description (if applicable)	Due date
D1	3D geometry (CAD model) of wing/pylon/nacelle aerodynamic design for a Green Regional Turbo-Fan A/C configuration		T_0 + 5 months
D2	Aerodynamic design of wing/ fuselage/pylon/nacelle geometry for a Green Regional Turbo-Fan A/C configuration	Report on the aerodynamic design of the concerned geometry and on the relevant aerodynamic performance assessment (CFD analyses) at transonic cruise, low-speed and off-design conditions (see Task 1)	T_0 + 5 months
D3	FEM optimised model of wing box for a Green Regional Turbo-Fan A/C configuration		T_0 + 9 months
D4	MDO aero-elastic modelling and preliminary structural lay-out of the wing architecture for a Green Regional Turbo-Fan A/C configuration	Report on the modelling of the optimised FEM of wing box and on the relevant structural and aero-elastic assessment (see Task 2)	T_0 + 9 months
D5	3D geometry (CAD model) of the wing/pylon/nacelle/HLD architecture for a Green Regional Turbo-Fan A/C configuration		T_0 + 8 months
D6	Aerodynamic design of wing/fuselage/pylon/nacelle/HLD geometry for a Green Regional Turbo-Fan A/C configuration	Report on the aerodynamic design of the concerned HLD architecture and on the relevant aerodynamic performance assessment (CFD analyses) at low-speed conditions (see Task 3)	T_0 + 8 months
D7	Preliminary design of HLD kinematic system (tailored to a wing/HLD architecture for a Green Regional Turbo-Fan A/C configuration)	(see Task 4)	T_0 + 10 months

4. Topic value (K€)

The total value of this work package shall not exceed:

450,000.--€

[four hundred 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-2010-1-GRA-02-008

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-02-008	Efficient CFD multiphysics programming research	Start date	*To**(Indicative: July/2010)*
		End date	*To +24***

1. Topic Description

Please indicate the expected proposal maximum length
15 pages

Scope of work

It is related to the support of GRA LNC WP2.2.7, to develop enhancements of efficiency driven CFD computing methodologies to be effected in the aerodynamic code, with the scenario of structure boundary behaviour and aerodynamic noise at mind.

Up to now much community work has entrenched CFD methodologies to unworkable overpowered aerodynamics-select few-only handling of the code and visualization, and this is not workable for large integrated multi-objective work where also “fast harmonizable results” are needed. Enabling this one needs focussed innovative “tricks”, adjustments to present CFD, hopefully in time for later speedy GRA integration work-troughs and clarifications.

Tasks

T1. Development of alternative methods for the efficient simulation of aerodynamic effects

T2. Providing conclusions to the end of industrial aerodynamics simulation for reducing algorithmic complexity, but not yet another overpowering Navier Stokes methodology only, having concern for more general use mesh portability and scope for improved implementation, digestable visualization, and interpretation.

T3. Implementation of parallelization schemes on the graphics processing unit (GPU) for improving the simulation performance

Reporting

R1, T0+ 6 months: will include conclusions with mathematical descriptions, for industrial purposefulness, rational treatment of the viscous fluid about an aerodynamic (with large laminar proportion and transitional turbulent, noisy behaviour) and outright bluff body.

R2, T0+12 months: intermediate report about the constructive approaches also in view of the sensitivities of practice GRA LNC, describing the work process to completion in view of T3 but also in view outlook of initiatives for improvement beyond these tasks under the 24Month grant agreement here, for say another year’s work.

R3, To +24 months: final report including the implementation of the GPU code described. The terms of delivery for the actual software implemented will be negotiated as a technical annex for partner GA and reference for the suggested implementation agreement. The report will include a Comparison with the outcome of work R2, exemplary trace calculations/visualizations, validations using the new simulation software methodologies.

The winning proposer will be supplied with a synopsis of methodologies at hand accompanying a particular neutral case from GRA LNC in order to understand better the metric and engineering scenarios and drive purposefully the work at T0

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

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date**
D1	Report 1	Development report	T0+6
D2	Report 2	Intermediate report	T0+12
D3	Report 3	Final report with SW code elements negotiated for the GA	T0+24

4. Topic value (K€)

The total value of 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 programme

5. Remarks

*** To and duration may be negotiated on the basis of the final JU time slots*

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRA-02-009

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-02-009	Adaptive wing structure concept for load matching	Start date	*To**(Indicative : July/2010)*
		End date	*To +19**

1. Topic Description

*Please indicate the expected proposal maximum length:**15 pages***

Scope of work

It is related to the support of GRA LNC WP2.2.1.5

Provide an **adaptive structure concept for the outer wing** of a regional aircraft in terms of **analytical equations** and **drawings**. Today many aerodynamic enhancing wing design motivated proposals have abounded without real fwd driven cases for aircraft development. Mainly, studies to "adaptive wing design" have hardly settled hard facts or decision bases for their down-selection with ample knowledge of their **identified potential limits by closed mathematics**. Past exercises conducted with the help of commercial codes without identifying generalized boundaries have a particularly self narrowing effect on how to judge a specific concept beyond for instance the finite element scenario arduously built up.

Without denying strength requirements, the structural response behaviour of the outer wing should achieve a capability of passively selecting its deformed shape with scope for wash in, wash out and neutral aerodynamic lift effect. To augment these effects the secondary inclusion of an actuator concept could be considered. Yet, one is not interested as such in the simple reproduction of a classical wing tip trailing edge aileron study that is "only" an important comparative case. The actuators are on "auxiliary-maybe terms" as auxiliary assets, emphasis though is on the best or even stand-alone adaptive structure concept. To contemplate the concept, two scoping dynamic pressure scenarios will be provided to vary the analytical consideration from i) a turbo prop to ii) a higher Ma No. jet application with also higher span load.

The analytic matter shall not be restricted to a sole focus of so-called tailoring of anisotropic skins against an isotropic material, rather exploit the view around the whole integrated response of skins, substructure, may optionally consider the slow to fast trailing edge approximation/replacement of a typical tip aileron function.

For this end a **carefully understood reduced order model (ROM)** would be constructed.

The structural response non-linear in nature could be brought to a linear comparison hopefully in further calculations by dropping well identified analytical terms

In contrast, the used coupled aerodynamics may be of simpler nature, down to even a fine strip theory approximation, co-jointly with an integration matrix method; but this aspect depends and is open to the proposer's ingenuity.

The underlying theme is the resulting capability to play transparently with generalised structural variables consolidated in a system of equations which allow through their solution to reverse engineer optimal aeroelastic equilibrium by way of insightful structural kinematics and elastics of the structural members.

Optimality criteria:

-low energy wash in/out deformation
-low power wash in/out deformation, say for attenuating a simplified sharp gust response

-low energy and stable interactions

- inclusion of arbitrary theoretical actuators to initiate the deformation with low energy need, whereby only a restricted number of actuators and restricted number of effected Degree of Freedoms are scoped when trying to utilize the energy of the incumbent aerodynamic forces too on top of the best passive structure outlay devised before.

-low weight

Otherwise:

A relaxed, thin airfoil approximization for drag can be made applicable.

Concepts and limitations of static, dynamic stability considerations to be taken up can be negotiated in the light of resources, capabilities at hand.

One may voluntarily wish to incorporate a philosophy to handle “fully stressed, fully performing” design to negotiate optimality in the calculus.

Of course, the base line conventional wing physical description will be shared with the partner in order to outline the necessary boundary conditions for the reduced order model of the tip wing structural and aerodynamic response.

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 *3 to 4 months*. This first matter will include the definition of the generalised variables of the structural members, 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 and or advanced materials, fittings, joints etc. (if well understood and feasible state of the art).

T2. Build the ROM, perform tracing and validation cases for physical soundness.
Simulate wash in, out and neutralising aerodynamic loading behaviour through selective feasible deformation by means of the structural concept

T3. Perform analysis and optimisation with the ROM for various dynamic pressures in 1-g cruise, also check the 2,5g case

T2&T3 together comprise roughly a *12 month* activity

T4. Highlight the theoretical limits to the concept, fill in the previously derived and now improved sketches, drawings and result plots. Moreover in the annex write up the analytical equations, employed matrices, data sets and units and all meaningful “How-Tos”,

Finally compile to a final report, R**C**

T4 comprising a *3 to 5 month* activity

Reporting

R**A**: Short Report “concept description” for Task 1

R**B, part 1**: Report the loads and shape on the selectively deformed outer wing, also the state values for the structural members, including involved deformation energy description and state value thereof. Mainly plots and explanatory text.

R**B, part 2**: Report on the optimisation and pertinent performance cases for the adaptive wing tip behaviour

R**C**: Final report with improved description of an optimal adaptive outer wing concept, underlying analysis equations and methodology in a concise manner.

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.

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	T0+3
D2	Report B, part 1	Including plots and descriptions thereof	T0+9
D3	Report B, part 2	Further Optimisation	T0+18
D4	Final Report C	One month concise compilation of the contract's work, final summary and outlook for further development.	T0 + 19

4. Topic value (K€)

The total value of this work package shall not exceed:

200,000.--€

[two hundred fifty thousand euro]

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

5. Remarks

If applicable

*** To and duration may be negotiated on the basis of the final JU time slots. Projections from internal WP2.2.1.5 synchronising and negotiation with the winning proposal coordinator may allow core duration to be increased*

If the concept and analytic representation are of good use/ promising the member will undertake to supply further complementary resources/expenses beyond the 19months, say to help complete on the one side a scholary objective but also just even open the hand for the partner's cooperation in the later fluition of such a promising concept(this could be an extension of ample resources and time to complete a doctoral thesis). This incentive thuogh would not in any way go against proposals aiming in contrast to restrict the work outreach to the core 19 months.

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRA-04-002

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRA-04-002	**ATM operational requirements** (Collection of information regarding Air Traffic Management operational requirements, available regulation, safety requirements and future expected features)	End date Start date	*T0+29* *T0*

1. Topic Description

Scope of work

Introduction

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 (Systems for Green Operations) 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.

After having defined optimized trajectories, new green technologies integrating these concepts will be developed and integrated in GRA flight simulator. On this simulation platform trials will be performed in order to evaluate the environmental impact reduction coming from the adoption of these new green technologies.

It is important to perform the assessment taking into account ATM environment. The main aim of this CfP is to collect all data necessary to develop an ATM scenario model to be integrated in GRA simulator.

GRA MTM activity is organized following the GRA 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

GRA Simulator, based on a turboprop solution, is a “man in the loop” real time flight simulator. This platform will be developed in two different steps:

- WP 4.2.2 - First step: in this stage no green technologies are implemented;
- WP 4.3 - Second step: previous GRA simulator will be updated in order to integrate the selected green technologies.

Following this approach the activity of this CfP will be performed in two steps: a preliminary set of data to be used for basic scenario model to be integrated in the first release of GRA simulator (WP 4.2.2) and an updated set of data for updated scenario model to be used for the second release of

GRA simulator (WP 4.3).

Activity

The main aim of this CfP is to collect all data necessary to develop an ATM scenario model to be integrated in GRA flight simulator. For this reason it will be necessary to collect the list of current and future ATM functionalities. In particular the available regulations and procedures, safety requirements and future expected air traffic management features are needed as input parameters to conceive the model which describes the scenario from the operative point of view.

CfP consists of the following activities:

- ATM rules collection
- Data collection

ATM rules collection

As a preliminary activity a document collecting ATM rules shall be produced. In this report, for all flight phases, information such as regulations, procedures, and safety aspects shall be included.

- Collection and synthesis of relevant worldwide activities in the field of ATM innovation and associated roadmap;
- for all flight phases, information such as regulations, procedures, safety aspects shall be included.

A table of content of this document will be provided at KOM (Kick-off meeting).

Three different releases are foreseen (see Fig.1) in order to keep this document updated and in line with possible innovations introduced by SESAR Research.

As GRA activity is focused on regional aircraft, this document shall include all peculiarities for regional aircraft.

Data collection

The ATM scenario model will simulate those Air Traffic System features that are relevant to the integration of simulated Flight Management System.

Therefore, in the framework of the ATM scenario modelling it will be necessary to collect the list of current and future ATM functionalities and requirements (further information will be released at the KOM).

The ATM functionalities description should cover en route control, approach control and tower/ground control. Main air traffic information on a selected number of adjacent ACC (Area Control Centre), APP (Approach Control Centre) and Airports must be provided together with a detailed description of the relation between adjacent control centres in order to support the modelling activities.

The selected candidate shall provide the following information:

- A preliminary description document reporting preliminary information about specific areas chosen as scenario for demonstration. Since GRA activity is focused on regional aircraft peculiarities, it should be noted that short-medium range mission shall be considered. These areas will be defined in WP4.1.2 (probably a portion of Italy or, as a second choice, France). Data will be requested for a set maximum of ten airports. All relevant information will be provided to the selected candidate at the KOM.
- A more detailed information shall be provided (in two steps) listed in a datasheet. Data to be collected, for each control centre, are listed in the **table 1** attached (This is a preliminary list; the final version will be provided during KOM).

SESAR

SESAR (Single European Sky ATM Research) is a current European research in charge of defining new ATM rules. The SESAR activities will finish by 2014, but possibly intermediate achievements will be available during the research. It is important to take into account preliminary results (available at the date) coming from SESAR both in ATM rules document and in the datasheet.

Planning:

The modelling activity will be developed in two steps. The first one concerns the basic scenario modelling, while the second regards the upgrade of the model.

The above listed information must be provided for both steps. In particular, in the second one, information has to be updated taking into account future expected air traffic management features such as those developed in SESAR.

During Kick Off Meeting the selected candidate will receive a detailed set of information as a support to the activity. In case SESAR inputs are planned to be available immediately after the CfP conclusion, a possible extension of few months will be evaluated during the KOM.

According to the planning (Fig.1), the selected candidate shall provide the following deliverables:

- ATM rules document (3 releases)
- A basic description document
- A preliminary set of data (for basic ATM scenario model)
- An updated set of data (for updated ATM scenario model)

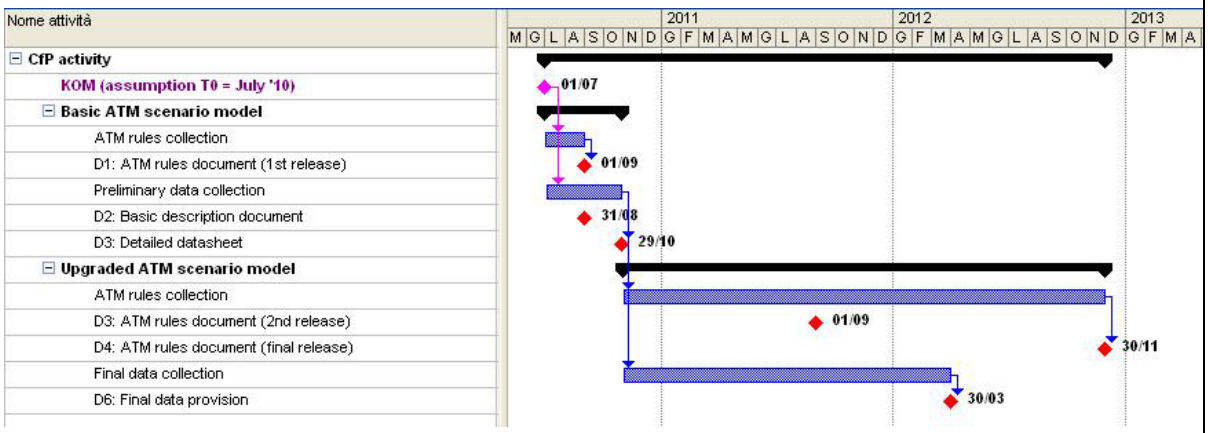


Fig. 1 - CfP planning (for T0 is assumed July '10)

Format:

Data must be provided in a proper electronic format (ex. Excel tables) in order to be used for the modelling activities. Details about data formats will be communicated at the Kick Off Meeting.

Table 1

Type of control centre	Context	Data
TWR/GND Tower-Ground	taxiways	Number, denomination, location, length, capacity, air traffic flows (average values), technical equipments.
	runways	Number, denomination, location, length, capacity, air traffic flows (average values), technical equipments.
	procedures	standard procedures, ATZ (Aerodrome Traffic Zone) borders, air traffic flows (average values), waypoints, circuit patterns, straight-in approaches, technical equipments.
	terrain	High resolution elevation maps representing the airport area.
	meteo conditions	Degradation of the main traffic parameters (flows, capacity) with the meteorological conditions.
	safety requirement	Minimum separation, particular safety requirements, regulation.
APP (Approach Control Centre)	procedures	APP area borders, STAR, SID, standard procedures, precision procedures, non-precision procedures, air traffic flows (average values), significant waypoints.
	safety requirement	Minimum separation, particular safety requirements, regulation.
	meteo conditions	Degradation of the main traffic parameters (flows, capacity) with the meteorological conditions.
ACC (Area Control Centre)	procedures	ACC area borders, airways (upper and lower), standard procedures, air traffic flows (average values), waypoints, interconnections, flight levels.
	restricted areas	TSA (Temporary Segregated Areas), borders, location.
	safety requirement	Minimum separation, particular safety requirements, regulation.
	meteo conditions	Degradation of the main traffic parameters (flows, capacity) with the meteorological conditions.

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

To achieve successfully the expected contributions, applicants should:

- have a proven experience in the ATM field;
- have a proven knowledge of SESAR Research;
- have skills in managing and elaborating data (average values, air traffic flows);
- certificate reliability, completeness and update of provided data;
- have participated to previous European research.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
-	Kick Off Meeting		T0
D1	ATM rules document (1st release)		T0+2
D2	Basic description document	Preliminary information about selected areas (Airports, APP, ACC).	T0+2
D3	Detailed datasheet	Datasheet reporting requested information for each control centre.	T0+4
D4	ATM rules document (2nd release)	D1 update	T0+13
D5	ATM rules document (final release)	D4 update	T0+29
D6	Upgraded detailed datasheet	Upgrade and refinement of information provided in D3.	T0+21

4. Topic value (K€)

The total value of 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 programme

5. Remarks

N/A

Clean Sky - Green Rotorcraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-GRC	**Clean Sky - Green Rotorcraft**	**4**	**4.844.000**	**3.633.000**
JTI-CS-GRC-01	*Area-01 - Innovative Rotor Blades*		**400.000**	
JTI-CS-2010-1-GRC-01-004	Performance/benefit assessment of advanced rotor configurations including active and passive blades		400.000	
JTI-CS-GRC-02	*Area-02 - Reduced Drag of rotorcraft*		**1.725.000**	
JTI-CS-2010-1-GRC-02-004	Contribution to design optimisation of tiltrotor for drag (fuselage/wing junction, nose, landing gear, empennage)		898.000	
JTI-CS-2010-1-GRC-02-005	Contribution to the aerodynamic design optimisation of a helicopter fuselage including its rotating rotor head.		827.000	
JTI-CS-GRC-03	*Area-03 - Integration of innovative electrical systems*			
JTI-CS-GRC-04	*Area-04 - Installation of diesel engines on light helicopters*		**497.000**	
JTI-CS-2010-1-GRC-04-002	Participation to the definition of optimal helicopter architecture for Diesel engine		497.000	
JTI-CS-GRC-05	*Area-05 - Environmentally friendly flight paths*			

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRC-01-004

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRC-01-004	*Performance assessment of innovative rotors*	End date	To +48 months
		Start date	To = 01/06/2010

1. Topic Description

1. Background:

In this subproject innovative active and passive rotor(blade) technologies for ecologically efficient helicopters are investigated. On rotor system level the benefit of rotational speed variations and their impact on the aircraft are studied with comprehensive flight performance tools. From this activity specifications will be derived for the related reference for specific blade design investigations.

The benefit impact on rotor performance and noise emission of selected design parameters in relevant steady flight conditions is systematically done with high fidelity, state of the art methods. Cornerstone of these studies is CFD simulation with validated rotor CFD codes. For forward flight trimmed CFD-CSD coupling using the CFD on one side and comprehensive flight mechanic tools with elastic blade modelling on the other side are applied. The achievable benefits are evaluated by (time-accurate) post-processing based on global and local performance indicators.

The designs will be further assessed through an established validation process. In GRC 1 important design parameters for the passive model rotor that will enter a wind tunnel campaign are identified and evaluated.

This Call for Partners looks for assistance in numeric simulations and specific tool developments as specified in the following GRC1 tasks:

GRC 1.1.7 Performance assessment of innovative rotors

GRC 1.1.8 Method development

GRC 1.2.1 Parametric studies for model rotor

The formation of a consortium of several partners working closely together in this call is explicitly desired. The partners shall be prepared to propose and cooperate on a common method set-up, and to harmonise and share developments and findings. Tool developments shall be delivered on source code basis.

2. Scope of work:

In task 1.1.7 rotor performance and noise assessments in hover and forward flight are required from potential partners. Here the substantiation of the state of the art performance calculation methods has to be executed together with the identification of method weaknesses and their alleviation. Innovative methodological approaches are searched, which strive for time efficient simulation on the one hand side and assure benefit evaluation on a modelling level reproducing blade local phenomena due to local parameter changes on the other. The partners shall be familiar with fluid-structure interaction on helicopter rotors in the frame of helicopter trim simulations. Access to a high performance computing facility seems obvious.

In task 1.1.8 method developments for optimisation of passive rotors shall be supported by the partners. The developments shall lead to an efficient rotor optimisation tool chain. The partners activity related to task 1.1.8 is particularly addressed to model improvement on all levels of rotor simulations for efficient use in algorithmic supported optimisation. Improvements on the following (physical) fields are envisaged:

- Solution of already known and extended deficiencies in rotor performance simulations identified in 1.1.7
  - = computational time and memory management,
  - = model accuracy,
  - = dynamic stall modelling in blade element momentum theory codes
  - = transition modelling applied on the rotor in forward flight in U-RANS CFD
- Free wake models for acoustics in optimisation (bridge the gap between comprehensive BEMT-blade element momentum theory and U-RANS CFD)
  - = coupling to a comprehensive rotor code
  - = enabling parallel simulation with efficient memory management
  - = acoustic post processing
- Provision/development of new or extension of existing optimisation algorithms which should be used and validated by the parameter study for the model rotor blade. These developments should be general enough to be applicable to an extended field of application in the future.
  - = mulit-parametric, multi-objective optimisation
  - = design of experiments and response surface methods
  - = surrogate model design and model reduction

In task 1.2.1 parametric studies with specific parameter set (e.g. non linear twist, anhedral) shall prepare the model rotor blade that will enter the wind tunnel. The model rotor shall be investigated in an equivalent full scale flight envelope with the above developed innovative methods. A blind simulation campaign defines the wind tunnel conditions and a meaningful test matrix. Maximum wind tunnel load conditions are extracted from the blind test simulations and are used in the blade manufacturing and structural design process. A final method validation takes place after wind tunnel test campaign in comparison to the obtained test data in order to proof the accuracy of absolute and/or relative performance indicators.

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

- Technical expertise on the various fields of helicopter rotor simulations (performance, acoustics, loads, vibration)
- Proven experience with aerodynamic simulation (free wake, U-RANS) tools applied to helicopters and related tool development
- Experience with research in the field of turbulence modelling and transition prediction
- Expertise in the field of accoustics and noise propagation moddeling
- Innovative ideas and methods in the context of passive rotor optimisation in hover and forward flight
- Experience with developement of state of the art optimisation algorithms, surrogate model design, model reduction for steady and unsteady problems

3. Major deliverables and schedule

Deliverable	Title	Short Description (if applicable)	Due date (month)
D01 → 1.1.7	Method analysis and improvements	Report and software modules	T_0 + 6
D02 → 1.1.7	Benefit assessment of full scale passive reference rotor	Report on simulation results	T_0 + 12
D03 → 1.1.7	Transfer of model scale optimisation results to full scale rotors in hover and forward flight	Report on simulation results	T_0 + 24
D04 → 1.1.8	Innovative advanced methods for rotor optimisation	Report and software modules	T_0 + 24
D05 → 1.1.8	Innovative advanced methods for improved passive rotor blade benefit predictions	Report and software modules	T_0 + 36
D06 → 1.1.8	Transfer of innovative methods to industrial software environment	Report on verification simulations	T_0 + 48
D07 → 1.2.1	Parametric study on performance optimal model rotors under wind tunnel conditions	Report	T_0 + 12
D08 → 1.2.1	Comparison of simulations and experimental results on performance optimal model rotors	Report	T_0 + 48

4. 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:

€ 400 000.00 (VAT not applicable)

[Four hundred 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 expected length of the technical proposal is between 20 (min) and 60 (max) pages.

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRC-02-004

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRC-02-004	Contribution to design optimization of tiltrotor for drag (fuselage/wing junction, nose and landing gear sponsons, empennage)	End date	T0 + 36 months
		Start date	T0

1. Background:

Within the Tiltrotor fuselage drag reduction activity it has been envisaged the need for an expertised partner to support the Consortium into the design process for enhancing the fuselage efficiency. This support is intended not to be confined to an iterative computing sequence, but it will be rather focused to setting up a comprehensive optimization environment embedded into the industrial process.

After a Technology Review in the field, already accomplished within this GRC, a specific design work is envisaged in order to improve the efficiency of selected components of the current ERICA tilt-rotor. The basic fuselage/wing junction, nose, landing gear sponsons and empennage have to be reviewed and optimized with the aim to minimize any detrimental effects on drag without significant penalties in lift and moments.

2. Scope of work:

The ultimate purpose of this topic is the aerodynamic optimization of fuselage/wing junction, nose, landing gear sponsons and empennage with the objective to reduce Drag forces and to improve the efficiency of the overall configuration. To accomplish this, the set up of a comprehensive “optimal design” procedure suitable for industrial purposes is required. The activity must be conducted by means of numerical CFD simulations. The full procedure and all the related tools must be fully integrated within the industrial design environment currently available at the Consortium sites, so the capability to use and integrate CAD, grid generator, solver and optimizer is mandatory.

First, the whole optimization procedure will be set up. Specifically, the optimization tool, already available and developed by the applicant, will be coupled with the commercial software codes available at the Consortium premises and consequently run there, with the optional support of a computer center. It is judged important that the optimizer (i.e. the numerical optimization software) has been conceived, written and implemented by the applicant; this to allow the introduction of any modification, improvement and special features that this kind of project may highlight.

The optimization will be focused on the efficiency improvement of the following components:

a) fuselage/wing junction: efficiency improvement in terms of Lift/Drag ratio

b) nose: drag reduction without penalization of the Pitching and Yawing moment of the Tail off configuration

c) landing gear sponsons: drag reduction without penalization of the Lift and Pitching moment of the Tail off configuration

d) empennage: efficiency improvement in terms of Lift/Drag ratio.

The impact of the rotor/propeller inflow on the overall installation efficiency must be taken into account by means of *a posteriori* analysis of the overall propulsion system, including the propeller and its inflow, mainly for empennage avaluation. To this purpose, the blade geometry will be not included directly into the optimization loop; in fact, the influence of the rotor will be considered as a boundary condition.

Once the full optimization process has been set-up at the Consortium premises, the geometrical shape

optimization will be addressed on the components configurations.

The optimization will be carried out at the operative points (flight conditions) defined by industry. For the massive optimisation runtime, if needed, the partner is asked to be supported by a dedicated computer center, where the necessary tools will be installed.

The development of an optimization environment (rather than a one-way code), including different optimization strategies, is mandatory. In this context, the leading industry must be left free to choose the algorithm most suitable to the specific optimization problem being considered. The different optimization techniques can be run sequentially or one at a time, depending upon the specific component to be designed.

Moreover, the capability to efficiently handle multiobjective problems is considered essential. Actually, due to the necessity of reducing computational costs, the optimizer must implement the most advanced tools to accelerate convergence toward the optimal solutions. To this purpose the leading industry will consider the possibility to refer to benchmarks published in the literature as a key aspect in order to validate the optimizer efficiency. The applicant must be able to demonstrate the performance of its own optimization environment on specific test cases selected from those available in the scientific literature.

Furthermore, it is considered of primary importance that the user can interact with the optimizer and monitor the whole process as it takes place, in order to give the designer a deep insight into the decision process. This is another reason for the optimization code to be implemented by the applicant, in that this will guarantee an appropriate degree of interaction with the rotorcraft designer .

Finally, the optimizer implementation is required to allow for an easy and cost-effective parallelisation within the industry.

The main output of the entire process will be the updated external geometry of the components, (fuselage/wing junction, nose, landing gear sponsons and empennage) optimized for high efficiency, in the required CAD format. Description reports supporting and substantiating the overall process and results are part of the output.

The selected partner is asked to closely and continously interact with the proposer for the overall duration of the project; such interaction is required at each level of the model set up in order to fully accomplish the industry needs.

The proposal must be structured into four main Tasks, with the associated Deliverables as better described in the following pages.

Task 1 - Basic configuration analysis and implementation of the optimization environment

Contents

Basic tiltrotor geometry (ERICA configuration) will be supplied to the selected partner by leading industry in CATIA V5® format and in the so called CAD repaired version. The geometry will include all the external surfaces. The nacelle will include the spinner, but not the rotor blades, while the engine intake will not include the internal ducts, being these geometry not relevant for this analysis. Furthermore, the proposing industry will supply some experimental data (global and local aerodynamic forces and moents) of the baseline isolated fuselage coming from wind tunnel campaigns (without rotor blades).

The applicant will:

a) set up the complete CFD model of the above Tilt rotor configuration

b) calculate the aerodynamics characteristics of the basic geometry and compare the flowfield

configuration with the one provided by the industry. The manufacturer will define the flight conditions at which the analysis must be performed

c) set up the complete optimization loop: in this phase the applicant will support the industry in setting up the model and evaluating the solution.

The optimizer software will be linked and embedded in an existing design and analysis environment at the Consortium premises, so the applicant will have to manage and integrate the softwares installed at the Consortium premises. The core optimizer software must be property of the applicant: this in order to have the full authority and knowledge to modify and to improve it, if required. The optimizer software will still remain property of the applicant, and it will be used at the industrial site only in the framework of this Topic. The full time attendance of the applicant at the GRC Consortium premises is then required.

Therefore, even in this phase the selected partner is asked to closely interact with the proposer in order for the optimization chain to fully accomplish the industry needs.

Tools

The tools to be applied for the analysis must be fully available at the Consortium site, this in order to guarantee the accomplishment of the next relevant tasks. For this reason it is mandatory that the applicant will use the following software codes to accomplish this task:

CATIA V5®, HYPERWORKS®, GAMBIT®, TGRID® and FLUENT®.

Deliverables

The applicant will release the Report on the baseline fuselage properties description. The analytical model input and output files must be also supplied (Deliverable D-1).

Moreover, the applicant will supply the optimization environment which will be ready and installed in the Consortium site (CAD, grid generator, solver, optimizer).

Site: This task can be accomplished at the applicant site.

Task 2 - Optimized geometry for wing/fuselage junction

Contents

In this phase the applicant, in close cooperation with the proposer, will run the optimization loop in order to identify the final optimised geometry of wing/fuselage junction for efficiency improvement in terms of Lift/Drag ratio. This is essentially a simulation task in which the overall methodology already set up in Task 1 will be applied and used to identify the optimal configuration.

The final geometry must comply with feasibility constraints in order to accomplish industrial needs for protoyping and testing. The full time attendance of the applicant at the GRC Consortium premises is then required. Therefore, even in this phase the selected partner is asked to closely interact with the proposer in order for the optimization chain to fully accomplish the industry needs.

Tools

The tool to be applied for this task is the comprehensive optimization tool, including the following software codes: the optimizer, CATIA V5®, HYPERWORKS®, GAMBIT®, TGRID® and FLUENT®.

Deliverables

The applicant will release the wing/fuselage junction optimization description report, showing the final optimized assessment of the new wing/fuselage junction geometry, and the CAD geometry of the optimized shapes (Deliverable D-2).

Site: This task must be accomplished at the GRC Consortium site.

Task 3 - Optimized geometry for nose, landing gear sponsons

Contents

In this phase the applicant, in close cooperation with the proposer, will run the optimization loop in order to identify the final optimised geometry of both nose and landing gear sponsons. The driving objectives are the drag reduction of both components, but taking into account the aerodynamic moments constraints of the overall tail off configuration. This is essentially a simulation task in which the overall methodology already set up in Task 1 will be applied and used to identify the optimal configuration. The final geometry must comply with feasibility constraints in order to accomplish industrial needs for protoyping and testing.

The full time attendance of the applicant at the GRC Consortium premises is then required.

Therefore, even in this phase the selected partner is asked to closely interact with the proposing industry in order for the optimization chain to fully accomplish the industry needs.

Tools

The tool to be applied for this task is the comprehensive optimization tool, including the following software codes: the optimizer, CATIA V5®, HYPERWORKS®, GAMBIT®, TGRID® and FLUENT®.

Deliverables

The applicant will release the nose and landing gear sponsons optimization description Report, showing the final optimized assessment of the new geometries, and the CAD geometry of the optimized shapes (Deliverable D-3).

Site: This task must be accomplished at the GRC Consortium premises.

Task 4 - Optimized geometry for empennage efficiency improvement

Contents

In this phase the applicant, in close cooperation with the proposer, will run the optimization loop in order to identify the final optimised geometry empennage surfaces. By definition, empennage will include both fin and tailplane. The effectiveness of the movable surfaces devices will be verified with *a posteriori* analysis. The driving objectives are the efficiency improvement in terms of Lift/Drag ratio. The actvity must take into account the aerodynamic moments constraints of the overall configuration in order to gaurantee the static stability requirements. This is essentially a simulation task in which the overall methodology already set up in Task 1 will be applied and used to identify the optimal configuration. The final geometry must comply with feasibility constraints in order to accomplish industrial needs for protoyping and testing.

The full time attendance of the applicant at the GRC Consortium premises is then required.

Therefore, even in this phase the selected partner is asked to closely interact with the proposer in order for the optimization chain to fully accomplish the industry needs.

Tools

The tool to be applied for this task is the comprehensive optimization tool, including the following software codes: the optimizer, CATIA V5®, HYPERWORKS®, GAMBIT®, TGRID® and FLUENT®.

Deliverables

The applicant will release the the empennage optimization description Report, showing the final optimized assessment of the new geometries, and the CAD geometry of the optimized shapes (Deliverable D-4).

Site: This task must be accomplished at the GRC Consortium premises.

Special skills, certification or equipment expected from the applicant

The applicant must have a qualified and demonstrated skill in the optimisation disciplines, mainly for CFD, and a specific knowledge on propulsion system. The optimization software must be property of the applicant, who must have the full authority to modify and to improve it, so the detailed knowledge of the theory and of the implementation software statements and routines are expressely required.

Moreover, in case of a pure numerical optimization loop the detailed knowledge of the following commercial software codes, from CAD to solvers, will be fully appreciated during the selection phase: CATIA®, HYPERWORKS®, GAMBIT®, TGRID® and FLUENT®.

List of publications on the relevant international journals is required to certify the expertise in the field. Moreover, the participation in the UE projects in the CFD workpackage will constitute an added value.

Major deliverables and schedule

Deliverable	Title	Short Description (if applicable)	Due date (month)
D-1	Basic configuration analysis and implementation of the optimization environment.	• Release of the baseline fuselage properties description Report. • Optimization chain ready and installed in the industry environment (CAD, grid generator, solver, optimizer).	T0+5
D-2	Optimized geometry for wing/fuselage junction	Release of: ▪ Optimization description Report ▪ CAD geometry of optimized wing/fuselage junction	T0+12
D-3	Optimized geometry for nose, landing gear sponsons	Release of: ▪ Optimization description Report ▪ CAD geometry of optimized nose and landing gear fairings	T0+24
D-4	Optimized geometry for empennage efficiency improvement	Release of: • Optimization description Report • CAD geometry of improved empennage.	T0+36

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:

€ 898,000.00 (VAT not applicable)

[eight hundred ninety eight thousand euro]

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)*

In this Topic description a long period attendance at the Consortium site is required. The cost for travel & accommodation should be estimated by the Applicant for the site most distant from its own premises, among the following ones: Marseille (F), Milan (IT), Munich (D), Yeovil (UK).

Once the Partner is selected, the Consortium site will be disclosed and the travel cost will be readjusted during negotiation taking into account the actual distance to travel, which can be only shorter than the initial estimate.

- The expected maximum length of the technical proposal is 100 pages.

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRC-02-005

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRC-02-005	Contribution to the aerodynamic design optimisation of a helicopter fuselage including a rotating rotor-head	End date	T0 + 48 months
		Start date	T0

1. Background:

The sub-project GRC2 “Drag reduction of airframe and non lifting rotating systems” of the Green Rotorcraft ITD aims among others at improving the aerodynamic characteristics of helicopter fuselages and rotor-heads. This implies a reduction of the drag without increasing the down-force, which usually characterises fuselage bodies in cruise flight.

Several helicopter classes (light, medium and heavy) are considered within the GRC2 sub-project, in order to cover as wide as possible a range among the future fleet. For each helicopter class, numerical analysis of the baseline configuration and of several improved configurations will be carried out by means of Computational Fluid Dynamics (CFD). Expected benefits of identified solutions will then be assessed through wind tunnel tests.

The helicopter configuration retained in this call-for-partner (CfP) belongs to the light weight class and features a blunt aft-body region and landing skids.

The successful applicant (Partner) shall support the GRC Consortium in the benefit assessment process of some aerodynamic design modifications. In addition to carrying out the wind tunnel measurement campaign, the partner shall also investigate a small subset of the experimental data through CFD simulations.

2. Scope of work:

The purpose of this topic is the assessment, through wind tunnel testing, of the benefits expected from a number of shape modifications that will be selected by the GRC Consortium for this wind tunnel drag reduction campaign.

In order to assess the benefits of the aerodynamic design modifications, which will be beforehand numerically predicted by the GRC Consortium, the *initial configuration* and *several modified ones* are to be measured in wind tunnel. Therefore, within the scope of the CfP, the following tasks are required:

Task 1: **Manufacturing** and **instrumentation** of a modular wind tunnel model of the specified fuselage design.

Task 2: **First wind tunnel campaign;** on the initial configuration and verification of results by means of CFD.

Task 3: **Second wind tunnel campaign;** on the first modified configuration.

Task 4: **Third wind tunnel campaign;** on the second modified configuration.

Task 5: **(Optional).** Specific wind tunnel measurements; with the objective of studying the effect of spoilers, strakes and vortex generators on the flow characteristics in the aft-body region.

Task 1 – Manufacturing and Instrumentation

Input:

The **GRC Consortium** will deliver the specifications for the model manufacturing and instrumentation. This will consist in a CATIA V5 file of the wind tunnel model accompanied by a specification document describing the necessary instrumentation **(In-1)**.

Model:

The **Partner** will manufacture and instrument the wind tunnel model following the specifications. The model shall be composed of a simplified fuselage cabin, engine cowling and tailboom (hereafter denoted by **F0**) – *i.e.* smooth loft with closed engine inlet and jet exhaust and with only a short segment of the tailboom without empennage –, the mast fairing (**M0**), the landing skids (**L0**) and the rotor-head (**R0**). Globally the model length is not to exceed 2 [m] and its frontal area 0.2 [m^2]. The fuselage cabin will be strongly simplified. Some geometric details will be retained only on the attachment region of the landing skids to the floor and around the rotor mast fairing.

The rotor hub must be realistic in terms of shape and adjustable in collective and cyclic pitch (no real time piloting). It shall be possible to keep it fixed or have it rotate around the mast axis at a given angular velocity. It shall be possible to tilt the rotor mast about its nominal position forward and backward by ±5° (no real time tilting). The blades will be cut at one third span. The flapping and lead-lag hinges can be suppressed.

The wind tunnel model shall be manufactured in such a way that the mast fairing (M0), the landing skids (L0), the rotor hub and hub cap (R0) can be easily dismounted, *i.e.* shall follow a modular construction. For the isolated fuselage configuration (F0) a smooth cover closing the mast fairing element will be manufactured too.

In order to keep to a minimum the aerodynamic interference between the wind tunnel mount and the model itself, the Partner shall connect the model to the balance through the tailboom (not through a floor connection).

Instrumentation:

The necessary instrumentation shall be arranged for by the **Partner** to perform the following measurements:

- Global loads and moments of the helicopter model;
- Static pressure measurements through pressure taps at not less than 100 locations on the fuselage surface defined by the GRC Consortium, in collaboration with the Partner;
- Unsteady pressure measurements through pressure transducers (*e.g.* Kulite®) at not less than 20 stations defined on the backdoor and engine cowling by the GRC Consortium in collaboration with the Partner;
- Field velocity measurements through Stereo-PIV on a certain number of windows behind the rotor-head and aft-body.
- Hot-wire anemometry for turbulence measurement.

Output:

Instrumented wind tunnel model **(D-1)**.

Task 2 – First Wind Tunnel Entry: *the Original Configuration*

Input:

The **GRC Consortium** will deliver the specifications for the first wind tunnel entry. A detailed measurement matrix will be provided (**In-2**).

Wind Tunnel Measurements:

The **Partner** will conduct the following wind tunnel measurements:

- Global and local measurements about the isolated fuselage (**F0**). PIV measurements will be carried out behind the mast fairing and the aft-body.

- Global and local measurements about the isolated fuselage with the original landing skids (**F0+L0**) so as to determine through difference the effect of the landing skids on the fuselage aerodynamic characteristics and flow properties. PIV and hot-wire anemometry measurements will be carried out behind the aft-body.
- Global and local measurements about the isolated fuselage with the original mast fairing and rotor-head (**F0+M0+R0**) so as to determine through difference the effects of the rotor-head and mast fairing on the fuselage aerodynamic characteristics and flow properties. PIV and hot-wire anemometry measurements will be carried out behind the rotor-head and mast fairing. Two sets of measurements will be here necessary, the first with a non-rotating (fixed) rotor-head and the second with a rotating rotor-head.
- Global and local measurements about the isolated fuselage with the original landing skids and the original rotating rotor-head (**F0+M0+L0+R0**). Only PIV measurements will be here necessary.

Numerical Verification:

In accordance to the specifications, the **Partner** will be asked to perform few, between two and four, CFD computations about the wind tunnel model to numerically cross-check some of the wind tunnel measured data. The choice of the CFD solver is left to the Partner, who will either generate the CFD meshes itself or take over meshes provided by the GRC Consortium.

Output:

The measured data coming from the four campaigns will be exhaustively documented in a dedicated deliverable. This deliverable shall comprise the experimental data base and a written report on the experiment itself and on the CFD validation activity **(D-2)**.

Task 3 – Second Wind Tunnel Entry: *Landing Skids Drag Reduction Campaign*

Input:

The **GRC Consortium** will procure two modified configurations of the landing skids and, if necessary, fairings too for a smooth junction between landing skids and floor. It will deliver the new model components (**L1** and **L2**) to the Partner together with the specifications for the second wind tunnel entry (**In-3**). The same measurement matrix as defined in Task 2 will be used.

Wind Tunnel Measurements:

The **Partner** will conduct the following wind tunnel measurements:

- global and local measurements about the isolated fuselage with the first modified version of the landing skids (**F0+L1**); PIV and hot-wire anemometry measurements will be carried out behind the aft-body;
- global and local measurements about the isolated fuselage with the second modified version of the landing skids (**F0+L2**); PIV and hot-wire anemometry measurements will be carried out behind the aft-body.

Numerical Verification:

In agreement with the GRC Consortium, the **Partner** will be asked to perform few, between two and four, CFD computations about the wind tunnel model to numerically cross-check some of the wind tunnel measured data. The choice of the CFD solver is left to the Partner, who will either generate the CFD meshes itself or take over meshes provided by the GRC Consortium.

Output:

The Partner will exhaustively document all measured data coming from the two campaigns in a dedicated deliverable. This deliverable shall comprise the experimental data base and a written report on the experiment itself and on the CFD validation activity (**D-3**).

Task 4 – Third Wind Tunnel Entry: *Rotor-Head Drag Reduction Campaign*

Input:

The **GRC Consortium** will procure two modified rotor-heads (**R1** and **R2**) and one or two modified mast fairings (**M1** and **M2**). It will deliver the new model components to the Partner together with the specifications for the third wind tunnel campaign (**In-4**). The same measurement matrix as defined in Task 2 will be used.

Wind tunnel measurements:

The **Partner** will conduct the following wind tunnel measurements:

- Global and local measurements about the isolated fuselage (**F0+Lx+M1+R1**); PIV and hot-wire anemometry measurements will be carried out behind the rotor-head; **Lx** is the landing gear, which will best perform between L1 and L2.
- Global and local measurements about the isolated fuselage (**F0+Lx+M2+R2**); PIV and hot-wire anemometry measurements will be carried out behind the rotor-head; **Lx** is the landing gear, which will best perform between L1 and L2.

Output:

All measured data coming from the two campaigns will be exhaustively documented in a dedicated deliverable. This deliverable shall comprise the experimental data base and a written report on the experiment itself and on the CFD validation activity (**D-4**).

Task 5 – (Optional) Effects of Spoilers and Vortex Generators

Input:

The **GRC Consortium** will procure spoilers, strakes, vortex generators that can be mounted on the existing fuselage surface (F0).

Wind tunnel measurements:

The **GRC Consortium** and the **Partner** will determine during which of the already planned wind tunnel entries such means for drag reduction of blunt geometries can be measured. No additional wind tunnel campaign is to be planned for this purpose.

Output:

These additional measured data shall be documented in one of the previously mentioned deliverables depending on the decision taken together by the GRC Consortium and the Partner.

Special Skills, Certification or Equipment Expected from the Applicant

The applicant must have a qualified and demonstrated skill in wind tunnel testing. It would even be preferred if he has already conducted wind tunnel test campaigns on helicopter fuselage configurations. Apart from an own wind tunnel or access to such a facility, CFD analysis capability is also required. With the model mounted in the test section, the minimum wind speed should reach at least 50m/s, the turbulence intensity should be less than 0.4%. The test section should have an area of at least 4.2m^2. The necessary instrumentation shall allow the measurement of aerodynamic loads, surface pressures, field velocities (*e.g.* Stereo-PIV), turbulence quantities (*e.g.* hot wires).

The mandatory skills are:

- Mock-up definition and manufacturing.
- Mechanical design for the kinematics definition of the rotor-head model.
- Aerodynamic measurements.
- Wind tunnel test management.
- Documented CFD experience.

Major Deliverables and Schedule

Input or Deliverable	Title	Short Description (if applicable)	Due date (month)
In-1	*Specifications for wind tunnel model manufacturing and instrumentation*	• *CATIA V5 file of the wind tunnel model* • *Specification document describing the necessary instrumentation*	*Input provided by GRC Consortium T0+4*
D-1	Instrumented wind tunnel model	• Model composed of fuselage with cowling and a segment of the tailboom (F0), landing skids (L0), mast fairing (M0) and rotor hub (R0) • All necessary instrumentation	T0+12
In-2	*Specifications for the first wind tunnel entry*	• *The measurement matrix will be specified in details*	*Input provided by GRC Consortium T0+12*
D-2	Wind tunnel measurement data and CFD analysis about the original configuration	• All measured data of the wind tunnel campaign on the original configuration (Task 2) • Summary of the CFD validation activity on this configuration	T0+24
In-3	*Specifications for the second wind tunnel entry*	• *The new landing skids (L1 and L2) will be delivered to the Partner together with the measurement matrix derived from In-2*	*Input provided by GRC Consortium T0+26*
D-3	Wind tunnel measurement data and CFD analysis about the second modified configuration	• All measured data of the wind tunnel campaign on the first modified configuration (Task 3) • Summary of the CFD validation activity on this configuration	T0+32
In-4	*Specifications for the third wind tunnel entry*	• *The new mast fairings (M1 and possibly M2) and the new hub caps (R1 and R2) will be delivered to the Partner together with the measurement matrix derived from In-2*	*Input provided by GRC Consortium T0+36*
D-4	Wind tunnel measurement data and CFD analysis about the third modified configuration	• All measured data of the wind tunnel campaign on the second modified configuration (Task 4) • Summary of the CFD validation activity on this configuration	T0+48

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:

€ 827 000 (VAT not applicable)

(eight hundred twenty seven thousand euro)

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 may concern only 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 expected maximum length of the technical proposal is 40 pages.

Clean Sky Joint Undertaking
JTI-CS-2010-1-GRC-04-002

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-GRC-04-002	*Participation to the definition of optimal helicopter architecture for Diesel Engine*	End date	To +20 months
		Start date	To

1. Topic Description

1. Background:

The JTI Clean Sky Green Rotorcraft research consortium is aiming at the development of low specific fuel consumption capabilities. These can be obtained using turbocharged Diesel engine technology developed in the automotive industry and integrating this technology on light helicopters to reduce gas emission level.

2. Scope of work:

The main objective and expected outcome of this research activity is to carry out the necessary studies to integrate a diesel engine on the optimal helicopter configuration and to define the engine and sub-systems technical specifications.

3. Tasks

- Definition of power drive and diesel engine installation loads.
- Thermodynamic analysis of diesel engine, the engine hot space and cooling of the diesel engine installed on the helicopter assessments. Engine heating emission to the engine bay, cooling and ventilation methods.
- Design of the engine suspension system and vibration reduction compatible with full helicopter vibration spectrum.
- Optimization of the helicopter electrical systems with diesel engine requirements.
- Optimization of oil and fuel systems with diesel engine requirements.
- Electrical system integration with digital engine control systems (FADEC).

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

- Master skill of the aircraft engine design, comprising diesel engine for aeronautical use.
- Knowledge of the diesel engine construction and good know-how in helicopter power drive analysis.
- Knowledge of the diesel engine dynamics. Power drive static and dynamic loads analysis skills (in diesel engine scope).
- Aerodynamics and thermodynamics of the diesel engine. Abilities to create advanced thermodynamic models with use of analytical methods to create heat & flow analysis (comprehensive of outdoor characteristic estimation).
- Master knowledge of the helicopter flight mechanics.
- Knowledge of the engine control system.
- Abilities to design and integrate on the helicopter an engine electronic control systems. Knowledge of the vibration reduction methods in mechanical systems, especially in aircraft.

3. Major deliverables and schedule

Deliverable	Title	Short Description (if applicable)	Due date (month)
D1	Loads and vibrations generated by diesel engine	Analysis of loads generated by diesel engine. Analysis of methods of vibration reduction in diesel engine installation.	T_0 + 36M
D2	Diesel engine thermodynamics	Diesel engine thermodynamic analysis. Engine cooling methods. Engine bay cooling methods.	T_0 + 36M
D3	Electrical, fuel and oil systems of diesel engine.	Optimization of design and installation methods for electrical, fuel and oil systems of the diesel engine.	T_0 + 36M
D4	Diesel engine FADEC system.	Helicopter integration with engine FADEC system.	T_0 + 36M

4. Topic value (€)

The total value of this work package shall not exceed:

497,000.--€

[Four hundred ninety seven thousand euro]

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

5. Remarks

No

Clean Sky Joint Undertaking
Call SP1-JTI-CS-2010-01
Sustainable And Green Engines

Clean Sky - Sustainable and Green Engines

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	**1**	**1.000.000**	**750.000**
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*			
JTI-CS-2010-1-SAGE-03-001	Fan annulus filler development		1.000.000	
JTI-CS-SAGE-04	*Area-04 - Geared Turbofan*			
JTI-CS-SAGE-05	*Area-05 - Turboshaft*			

Clean Sky Joint Undertaking
JTI-CS-2010-1-SAGE-03-001

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-SAGE-03-001	**Fan Annulus Filler Development**	Start date	*July 2010*
		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.

In the fan the rotating blades are mechanically held by a disk. To maintain weight efficiency the inner annulus flow line is made up by an *Annulus Filler* (or fan platform). This part is held by the disk and must seal against the blades to prevent leakage flow. The main loading is self-weight, but the filler must also be able to survive bird-strike and fan-blade out conditions.

In this context, R&TD activities are foreseen, on the annulus filler, with the objective to demonstrate technologies via running in the demonstrator engine, to mature the filler and associate fan parts in the large 3-shaft engine, in view of a potential product application.

It is envisaged that Organic Matrix Composite and/or Lightweight metallic materials will be the key to reducing the weight of both the filler and associated fan parts it may interact with. However in order to enable this the design space will need to be investigated in terms of materials, manufacturing processes and joints.

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: Support Annulus Filler design & validation

The design of the annulus filler and associated mating parts will be carried out by Rolls-Royce. However the manufacturing partner is requiired to support this activity to ensure the design is realisable. To do this the following activiteis are required:

- Support, from early phases of fan rotor assembly design, through annulus filler detailed definition, to annulus filler manufacturing, The early phases will be key to success with the selection of the overall concept.
- Support design for manufacture, design for cost and design for service events during the design phase, Support the Manufacturing Capability Readiness reviews which are one part of the validation assessment of the annulus filler.
- As well as providing manufactured articles (see task 3) support the other validation tests perfomed with technical advice and input. These will include (but are not limited to fatigue tests, impact tests and engine running). This will culminate with Technology Readiness Level (TRL) reviews to verify that the required maturity has been reached.

Task 2: Indentification, Selection and Developement of Materials and Manufacturing Processes for Annulus Fillers

The design and resulting manufacturing methods for the annulus fillers is a result of the programme, but it is anticipated that Organic Matrix Composite technologies (such as fibre preforming, RTM or other out-of-autoclave moulding techniques), lightweight metal processing (including forming, machining etc) and assemby and inspection technologies (e.g. bonding and NDE techniques) will be key.

- Supported by Rolls-Royce, identify suitable materials and manufacturing processes for the annulus filler.
- Perform sufficient manufacturing trials to select cost-effective materials and processes. Then, supported by Rolls-Royce, down-select the final materials and manufacturing processes for the annulus filler.
- Develop the manufacturing processes to ensure that the resulting annulus filler can meet functional (e.g. geometry), quality (e.g. defects) and cost. As well as the primary manufacturing process development, inspection and quality procedures (to agreed quality processes) should be developed.
- Although in this programme only a limited number of fillers will be produced, the quality and cost implications of the processes for volume supply should be considered by the partner.

Task 3 : Manufacturing of Annulus Fillers

- Develop and design suitable tooling for the filler manufacture. Procure the required tooling and any bought-in parts.
- Manufacture and supply to Rolls-Royce 2 full sets of full-size annulus fillers for engine and rig running plus spares (about 45 fillers in total). This includes the structural body of the filler with joint mechanism to the fan disk, and the seals on the filler's edges to prevent unwanted airflows on the engine.
- Provide documentation associated with the process control and inspection of the annulus fillers to support the validation of the annulus fillers in task 1.

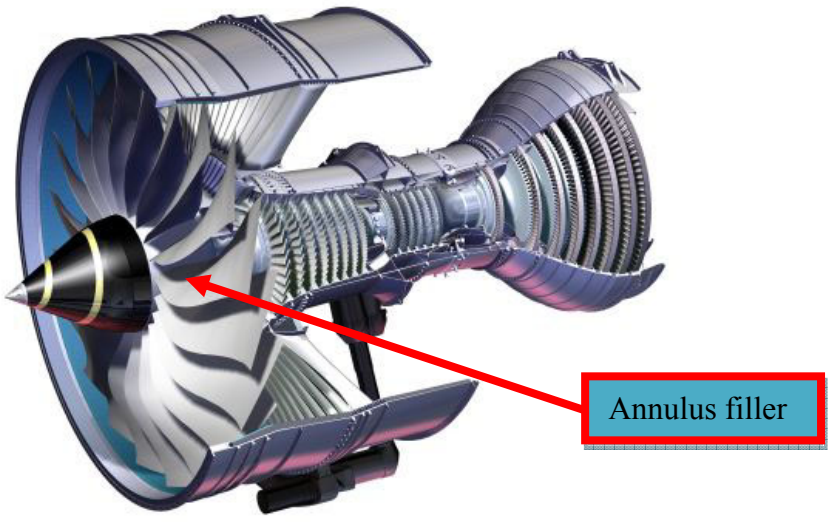
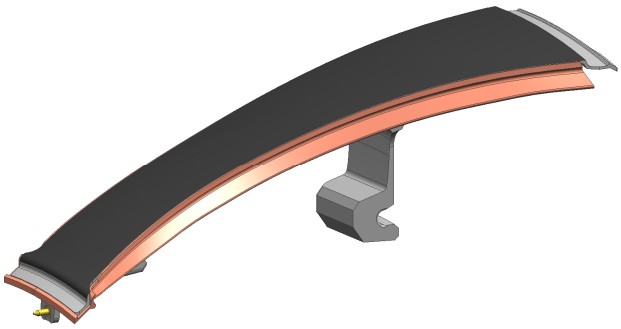


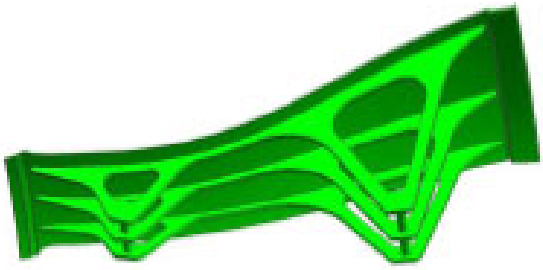
Figure above shows the location of the annulus filler in the fan system and illustrates its function in providing an aerodynamic flow surface at the inner annulus of the fan.

A range of potential solutions are shown below to indicate the design flexibility that is available to the Partner in terms of material selection, fixing and sealing solutions and geometry. These are not intended to limit the proposed solutions; proposals should showcase the Partner's technology development and innovation by the Partner is encouraged. Rolls-Royce will work with the Partner to integrate the proposed solution into the composite fan system.

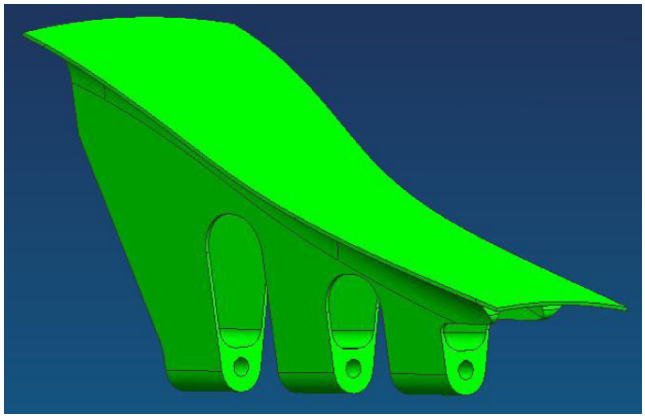
Typical metallic annulus filler with seals:



Potential optimised metallic design:



Potential composite material design:



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. 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 an high readiness level to minimize program risks is an asset.

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

The partner needs to demonstrate to be in the position to have access to the manufacturing facilities required to meet the goals.

The activity will be managed with a Phase & Gate approach and management plan has to be provided. Rolls-Royce will approve gates and authorize progress to subsequent phases.

Technical/program documentation, including planning, drawings, manufacturing and inspection reports, must be made available to Rolls-Royce.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.1	Design for Manufacture output	List of design for manufacture ideas and drawings as produced in joint working sessions.	Oct 2010
D1.2	Manufacturer's Design definition statement	Manufacturing report underwriting suitability of final design for manufacture	Feb 2011
D1.3	Capability Readiness Review documentation	Documentation suitable to demonstrate that TRL=6 has been reached	Jun 2013
D2.1	Documentation to substantiate lab development of fillers.	Analysis report of preliminary manufacturing development suitable to demonstrate ability to manufacture full-size parts.	Jun 2011
D2.2	Quality plans	Documentation to underwrite the manufacturing of quality parts	Sept 2011
D2.3	Documentation to substantiate full-size filler manufacture	Analysis report of final annulus filler manufacturing and inspection suitable to prove key attributes have been reached.	Sept 2012
D3.1	Manufacturing articles for test	Manufacture of 45 annulus fillers and associated conformance documents.	Dec 2011

4. Topic value (€)

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

1,000 k€

[one million Euro]

This topic value is a maximum gross value for the work package. Awards between 50% and 75% of this value may be made by the Clean Sky Joint Undertaking.

5. Remarks

If applicable

Clean Sky - Smart Fixed Wing Aircraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	**18**	**6.350.000**	**4.762.500**
JTI-CS-SFWA-01	Area01 – Smart Wing Technology		**5.850.000**	
JTI-CS-2010-1-SFWA-01-004	Support of icing-tests (runback-ice behaviour of surfaces) and icing mechanisms		230.000	
JTI-CS-2010-1-SFWA-01-005	Support of development of riblet-application device		260.000	
JTI-CS-2010-1-SFWA-01-006	Concept for automated riblet-application (robot-concept)		260.000	
JTI-CS-2010-1-SFWA-01-007	In field surface inspection tool (for bonded repair)		150.000	
JTI-CS-2010-1-SFWA-01-008	Construction and assembly of a prototype surface pre-treatment tool for in-field use		150.000	
JTI-CS-2010-1-SFWA-01-009	Protoype of curing tool		150.000	
JTI-CS-2010-1-SFWA-01-010	Phased array ultrasound and NDT measurements		150.000	
JTI-CS-2010-1-SFWA-01-011	Prefabricated CFRP Parts		150.000	
JTI-CS-2010-1-SFWA-01-012	Concept study: Cleaning device for wing leading edge		40.000	
JTI-CS-2010-1-SFWA-01-013	Active Flow Control (AFC) techniques on trailing edge shroud for improved high lift configurations - design, manufacture and tests		460.000	
JTI-CS-2010-1-SFWA-01-014	Manufacturing of the test set up for gust load alleviation in the Onera S3Ch WT facility		400.000	
JTI-CS-2010-1-SFWA-01-015	Development and test of a fluidic actuator prototype (MEMS type) on aircraft level		190.000	
JTI-CS-2010-1-SFWA-01-016	Ultra low power autonomous wireless stain gauge data acquisition unit		800.000	
JTI-CS-2010-1-SFWA-01-017	Fluidic sensor for separation detection in flight – development, design, C&M, and tests		610.000	
JTI-CS-2010-1-SFWA-01-018	Development and test of subsystem of active flow control actuator based on pneumatic principles		290.000	
JTI-CS-2010-1-SFWA-01-019	Flown Control Actuator System development, manufacture and demonstration for high lift		620.000	
JTI-CS-2010-1-SFWA-01-020	Structural designs and tests for integration of active flow control concepts on trailing edge high lift device		940.000	
JTI-CS-SFWA-02	Area02 – New Configuration		**500.000**	
JTI-CS-2010-1-SFWA-02-006	Design and manufacture of a ground-based structural/systems demonstrator		500.000	
JTI-CS-SFWA-03	Area03 – Flight Demonstrators			

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-004

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-004	Support of icing-tests (runback-ice behaviour of surfaces) and Icing mechanisms	Start Date	01.07.2010
		End Date	31.12.2011

1. CfP Description

Subject of this call for proposals are icing-tests, where the behaviour of runback-ice on surfaces could be investigated. Furthermore, it should be part of these tests, the investigation of under-cooled water-droplets approach on a test-surface and if they freeze immediately. Test facilities using ice-rain conditions or rime-ice conditions are available, but facilities that are able to apply under-cooled water-droplets are missing.

The purpose of this CfP is to find a supplier for icing tests where under-cooled water droplets are applied to test panels or test model-airfoils under realistic conditions (Air and Surface Temperature -20 to 0°C, Liquid Water Content 0,2-2,5 g/m^{3,} Air Speed 80 m/s).

Approximately 30 samples (coated profiles, coating to be supplied by an SFWA member, design of profiles/airfoils to be adjusted to the wind-tunnel testing conditions) have to be tested in 3 portions.
The wind speed and the approaching speed of the water-droplets should be possible from 250 km/h minimum and should be able to be increased up to 350 km/h. The tested samples have to be investigated in terms of iced area in terms of force of adhesion of the ice (measured with a tool that will be supplied by an SFWA member and in terms of runback-ice behaviour by heating the leading edge of the test foils.
The tests have to be documented by photos and movies, showing the accretion of ice at the surface of the samples before and after heating the leading edge.

Another part of this call for proposal is the scientific support for the understanding of icing mechanisms. Previous studies have been shown, that these mechanisms as well as the adhesion characteristics and sublimation processes are a vast scientific field. Nevertheless, results of this scientific work are urgently needed to understand the icing behaviour of surfaces under varying conditions and finally to predict them.

Furthermore, for coating developments it is absolutely necessary to take this knowledge into consideration.
The work should include the newest scientific knowledge on basic icing studies and should give explanations concerning its relevance to anti-ice surfaces. Furthermore, recommendations should be given in terms of suitable surfaces on the basis of physical and chemical behaviour.

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

- The applicant has to have a wind-tunnel which fulfils the following requirements:
  - Air-speed: 250 km/h – 350km/h
  - Possibility to produce under-cooled water-droplets (to the proved by test runs)
  - Possibility to investigate runback-icing behaviour
- The applicant should have a sound background in test-conditions for aviation industry
- The applicant has to have scientific experiences in the research field of “ice”, including physical and chemical background

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D02-01	Proof of under-cooled droplets and runback-ice formation	A proof of the possibility of production of under-cooled water-droplets and runback–ice testing has to be available	01.10.2010
D02-02	First portion of samples investigated	The first portion of samples (approx. 10) have to be tested and documented	31.12.2010
D01-03	Second portion of samples investigated	The second portion of samples (approx. 10) have to be tested and documented	30.03.2011
D01-04	Third portion of samples investigated	The third portion of samples (approx. 10) have to be tested and documented	31.07.2011
D01-05	Report	Port including all test-parameters, results, photos, movies etc. has to be delivered in electronic and paper-version in English-language	31.10.2011
D03-01	Collection of basic icing mechanisms	This collection shall help to select and develop appropriate anti-ice surfaces	31.12.2011
D03-02	Study on icing behaviour – Report	Comprehensive study, including varying (and relevant) icing conditions and its effects on surfaces	31.12.2011

4. Topic Value

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

€ 230.000,--
[two hundred thirty thousand euro]

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

6. Remarks

(Use this example only if required!)

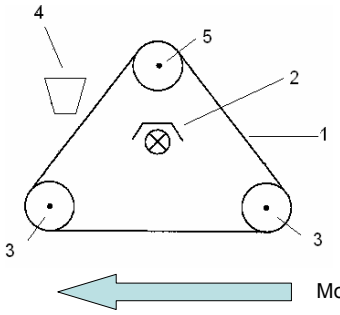
Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-005

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-005	Support of development of riblet-application device	Start Date	01.07.2010
		End Date	01.07.2012

1. Topic Description

Subject of this call for proposal is the development of a riblet-application device as a tool for automated application of riblet-paints.
The development should include the design of this device (based on a prototype which has been developed by an SFWA member), the construction of the device as improved prototype, the support of application tests to be carried out using a robot at an SFWA member site and the improvement of the system based on the results of the robot-trials.
The application device consists of a roller-applicator that is equipped with a UV-lamp for paint curing. The working width of the device is 50cm. The basic function is described in the figure below. The details of the interface to the robot-handling system, sensors etc, will be provide at project start.



1: Embossing tool with negative microstructure on the outside
2: UV-curing unit
3: Soft roller; flexibility adapted to the curvature of the surface
4: Paint dosing unit
5: Guide roller

Patent: DE 103 46 124 B4

The expected solutions from the development are:
- construction and building of a prototype for robot-application
- construction and building of a device for automatic cleaning of the embossing tool (Item 1 in the figure)
- implementing of a automatic alignment of the embossing tool (Foil, Item 1)
- optimization of the device through robot trials until feasibility is proven

Additionally the integration of sensors for the fine-steering of the application procedure and the integration of an
in-line surface Inspection tool (to be developed in WP 1.1.3) has to be included in the design of the

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

- The applicant has to have a sound background in the design of optical/mechanical devices
- The applicant has to have experience in the usage of transparent silicone-materials
- The applicant has to have high skills in usage and integration of optical sensor-systems
- The applicant has to have experience in the design and construction of mechanical and electronic interfaces between robots and other devices (sensors etc.)

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D04-01	Completion of design	The design work, including drawings, list of parts etc.	31.12.2010
D04-02	Manufacturing of the device	The device has to be constructed including control soft- and hardware	30.06.2011
D04-03	Support of robot-trials	Test runs with the device will be performed at Fraunhofer-IFAM. The trials have to be supported by the applicant. Several test runs will probably be necessary.	31.12.2011
D04-04	Optimization of the device	The device has to be optimized using the results of the test-runs. A detailed data sheet has to be delivered.	01.07.2012

4. Value of topic

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

€ 260.000,--
[two hundred sixty thousand euro]

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

5. Remarks

(Use this example only if required!)

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-006

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-006	Concept for automated riblet-application (robot-concept)	Start Date	01.07.2010
		End Date	31.12.2012

1. CfP Description

Subject of this call for proposal is the development and a proof of concept for automated handling of a riblet-application device (to be developed and constructed in JTI-CS-2010-1-SFWA-01-005) for serial production of aircrafts based on the employment of robots or other automated handling systems.

This application device is a roller-based paint applicator that has to be guided over the surface of an aircraft (fuselage, parts of wing, vertical tail plane, horizontal tail plane) in order to apply the riblet-paint.

The applicant shall develop a concept for an automated handling system that is capable of guiding the roller applicator over the above mentioned surfaces.

The goals are:
- application speed between 2 and 10 m/min (width of the roller-device: 50cm)
- precision of application (distance from track to track) +/- 2mm

The concept should be compatible to external final paint shop facilities and the aircraft shape. Additionally a measurement and control technique (defined and supplied by ITD partners in the progress of their workpackages) has to be integrated into the robot-concept.

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

- The applicant has to have a sound background in the design of optical/mechanical devices
- The applicant has to have high skills in usage and integration of optical sensor-systems
- The applicant has to have experience in the design and construction of mechanical and electronic interfaces between robots and other devices (sensors etc.)

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Completion of concept	Concept study available, including drawing or sketches	31.12.2010
D02	Manufacturing of a prototype of handling device	The device has to be constructed and supplied for application trials	31.07.2011
D03	Support of application-trials	Test runs with the device will be performed at SFWA member site. The trials have to be supported by the applicant. Several test runs will probably be necessary.	30.06.2012
D04	Optimization of the device	The device has to be optimized using the results of the test-runs. A detailed data sheet has to be delivered.	31.12.2012

4. Value of CfP workpackage

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

€ 260.000,--
[two hundred sixty thousand euro]

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

5. Remarks

The details about compatibility of handling device with the requirements in terms of space etc. of existing paint shops will be discussed with the successful applicant.

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-007

Topic Description

CfP Nr.	Title		
JTI-CS-2010-SFWA-01-007	In field surface inspection tool (for bonded repair)	Start Date	01/07/2010
		End Date	31/12/2011

1. CfP Description

In bonded repair, high requirements exist for the quality (cleanliness) of the substrate surfaces in order to achieve high adhesive bond strengths. The detection of contaminations on surfaces of CFRP structures before bonded repair is an important requirement in order to apply an efficient surface treatment.

Several requirements exist for such a detection technique: Measurements must be carried out rapidly and fully automated. In addition the detection techniques must be sensitive for the relevant contaminants, measurement reproducibility must be high and the technique must be suitable for use in technical environments where bonded repair takes place.

The CfP addresses the testing and development of a suitable technique that detects type and quantity of contaminations that occur in the field of bonded repair of aircraft composite structures (typical contaminations are hydraulic liquids, humidity or de-icing fluids).
To complement the techniques already studied by the CleanSky members, the method to be investigated should be based on mass spectrometry and/or gas phase sensors (like electrical noses). Excluded from the call are methods that are based on the interaction of light and matter.

It has to be investigated if relevant contaminants can be detected and quantified by these techniques. Especially, it should be studied how such a technique can contribute to achieve certification of bonded repair of aircraft composite structures.
After testing and calibration, the construction and assembly of a prototype surface inspection tool shall be realized.
In addition a set up has to be developed that is suitable for the application in bonded repair scenarios.

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

- Knowledge in the field of surface/material analysis by mass spectrometry and/or gas phase sensors
- Sound record in (trace) analytical chemistry
- Experience in tool development and automation processes

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Testing of measuring principle	Testing of detection method in order to detect critical contaminations on CFRP	T+3M
D02	Set up development	Development of an set up suitable for repair application	T+12M
D03	Calibration	Calibration of measuring device	T+18M
D04	Testing of measuring device	Testing of measuring device under repair conditions	T+22M

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. Remarks

(Use this example only if required!)

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-008

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-008	Construction and assembly of a prototype surface pre-treatment tool for in-field use	Start Date	01/07/2010
		End Date	31/12/2011

1. CfP Description

Subject of this call for proposal is the construction, assembly and optimisation of a prototype surface pre-treatment tool based on laser technology for field repair of composite structures.

In this context, the term pre-treatment should be understood as (a) cleaning and (b) activation of the surface.

Cleaning means to remove contaminants (e.g. water, oil, hydraulic fluid, dust) from the surface that prevent good adhesion of a repair patch to the CFRP surface. Activation means to modify the surface (e.g. incorporation of functional groups into the surface) to improve the formation of covalent bonds of an adhesive and the CFRP surface. The area that needs to be treated is located on the wing structure of a large civil aircraft and has a dimension of approx. up to (10 x 10) cm^2.

The project is sub-divided into the following tasks:

- Optimisation of the head of laser pre-treatment system in terms of effectiveness, applicability and handling
- Development of movable optical shielding systems for the use of laser in repair shops, hangars, in-field
- Development and optimisation of suitable exhausting systems
- Investigations on recontamination by ablated material
- Support applying laser technology onto CFRP-surfaces

The expected maximum length of the proposal is 10 pages.

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

- The applicant has to have a full ISO 9001:2000 certification
- The applicant has to have a calibrated laboratory environmental test unit of laser systems containing mobile, fiber coupled and handheld laser cleaning equipment with an average power of up to 1000 Watts laser power and portable, cordless battery powered laser units with an average laser output power of up to 20 Watts
- The applicant should have a sound industrial background in building manual and mobile laser units for surface cleaning especially laser coatings removal and laser based pre-treatment applications
- The applicant should have experience in outdoor use and laser safety measures for industrial laser cleaning and surface treatment applications
- The applicant shall have industrial background in use and optimization of fume extraction technology

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Concept Report	Description of technical concept of laser head	T+3M
D02	Laser head	Delivery of optimised laser head	T+6M
D03	Exhausting system	Delivery of optimised exhausting system	T+9M
D04	Shielding system	Delivery of shielding system	T+18M
D05	Test report	Test report on pre-treatment of CFRP samples	T+22M

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. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-009

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-009	Prototype of curing tool	Start Date	01/07/2010
		End Date	31/12/2011

1. CfP Description

The repair of components of primary aircraft structures made from composite fibre reinforced plastics (CFRP) is essential in achieving a sustainable aircraft production with a minimum of life cycle costs, in addition to saving essential resources.
Bonded repair of damaged CFRP structures is a favourable repair/maintenance solution because it does not disrupt the integrity of the composite material and because it can restore fully the original properties (e.g. load level) of the structure.
Curing is an essential step in the repair process and requires careful consideration. While various curing equipment exist today, the outcome of process errors in the curing step (e.g. temperature distribution) on bond reliability is not fully understood.

This call addresses support activities for the field repair of CFRP laminate structures.

The repair scenario is based on a scarf geometry using prepreg composite patches and film adhesives. For bonded repair, the curing of the composite repair patch is of great reliability of the repaired component. Therefore, the work should focus on the development of a reliable curing method. It may consist of the development of a new curing tool or of the improvement and detailed investigation of an innovative curing method. The inhomogeneity of the temperature field and its consequences for the bond strength has to be investigated. The robustness of the curing process shall be demonstrated, e.g. the influence of process parameter variations on the reliability of the adhesive bond (in cooperation with CleanSky project partners).

It is expected that the results of this work also contributes to the demonstration activities in CleanSky. Therefore, part of the work may have to be carried out at the facilities of a RMO company in Europe (maximum 5 days) with the curing device at the disposal of the project members.
The part with the damage may have the size of an actual aircraft wing. However, the size of the damage itself is on the order of up to (5x5) cm^2 and the area that needs to be cured has a dimension of up to (65x65) cm^2 due to the scarf geometry of the repair patch.

The expected maximum length of the proposal is 8 pages.

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

- experience in tool development for curing processes
- sound knowledge of the CFRP materials
- good knowledge/experience of bonded repair solutions of composites in the aerospace sector

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Critical review of design of curing device		T+10M
D02	Curing device/methodology for field use ready		T+16M
D03	Support in using the developed tool		T+16M
D04	Demonstration of reliability of curing process in field repair / robustness assessment		T+22M

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. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-010

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-010	Phased array ultrasound and NDT measurements	Start Date	01/07/2010
		End Date	31/07/2011

1. CfP Description

Composite materials are used increasingly in aircraft production.

Composite parts like Carbon Fibre Reinforced Plastics (CFRP) require adequate **non-destructive testing** (NDT) methods. Especially with an approach for repair solution of CFRP structures non-destructive inspections are required which are capable of measuring defects in complex geometries with limited access. The latter point is important for inspection of repaired parts of aircraft in use.

Hence research and development are aimed to compare different inspection methods regarding sensitivity, reliability and mobile operation. To achieve certification of bonded repair, adequate NDT technologies that can probe the quality of the bonded repair are essential.

Flaws to be detected are delaminations and debondings, porosity or foreign body inclusion.

The NDT methods which should be compared are ultrasonic testing (with single element transducers and linear phased arrays with a lateral resolution in the mm/or sub-mm range) because it is the most common method for NDT, shearography, and laser ultrasound. The methods shall be adapted for use of the parts manufactured and investigated in this project.

The technology of a composite patch bonded over a damaged area was developed for repair of large skin panels, which are not easy to remove from the structure. Depending on the thickness of the patch and its geometry, the applicability of the NDT techniques should be evaluated.

The size of the structural parts to be examined can be as large as a current wing structure of large commercial aircrafts, with the size of the repair area on the order of (65 x 65) cm^2 and a patch thickness of 2-3 mm. Especially new strategies for damage identification going beyond the current state of the art should be studied. The capability of the NDT methods to guarantee a high-quality and highly durable bonded repair in order to achieve certification of flightworthiness should be assessed.

The expected maximum length of the proposal is 10 pages.

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

- Knowledge of NDT of CFRP materials, typical damages of such structures and bonded component parts
- Capability to perform measurements with different NDT techniques such as ultrasonic testing, shearography and laser ultrasound
- Familiarity with bonded repair solutions of composites in the aerospace sector

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Screening of NDT methods	Comparison of the different methods such as standard ultrasound, shearography and laserultrasound in order to detect the above mentioned defects	T+3
D02	Development of strategies for mobile NDT		T+9
D03	Assessment of NDT methods	Assessment of possibilities and limits of NDT methods to guarantee a reliable longterm bonded repair	T+21

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. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-011

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-011	Prefabricated CFRP Parts (Design, manufacture, and analysis of CFRP patches for bonded repair of composite aircraft structures)	Start Date	01/07/2010
		End Date	31/12/2011

1. CfP Description

The repair of components of primary aircraft structures made from composite fibre reinforced plastics (CFRP) is essential in achieving a sustainable aircraft production with a minimum of life cycle costs in addition to saving essential resources.
Bonded repair of damaged CFRP structures is a favourable repair/maintenance solution because it does not disrupt the integrity of the composite material and because it can restore fully the original properties (e.g load level) of the structure.

This call addresses the design, fabrication, and analysis of CFRP laminate structures within the repair project of CleanSky.
The research should focus on the design and the fabrication of CFRP repair patches that can be used in the scarf repair of damaged laminate structures using film adhesives and prepreg material.
For the proper design of the patch, analysis tools for damage assessment are needed. Based on this analysis, optimized repair patches should be designed/manufactured that will be used by the partners of the project.

In addition the work should address the fabrication of CFRP components that exhibit typical damages encountered in the service life of an aircraft. These parts will then be used for demonstrator activities of the repair solution in course of the project. Also support in the analysis of the structural integrity/mechanical performance of the composite components (before/after repair) is desired.

Part of the work may need to be carried out at the facilities of one of the project members in Germany for a limited number of days. The specific materials and samples sizes will be decided on in course of the project.

The expected maximum length of the proposal is 8 pages.

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

- sound knowledge of the newest CFRP materials and typical damages of such structures
- (external) capability to fabricate CFRP structures with very high precision and accuracy and high surface quality
- familiarity with bonded repair solutions of composites in the aerospace sector

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Design study on patch geometry		T+10M
D02	Fabrication of patches		T+16M
D03	Fabrication of damaged CFRP components		T+16M
D04	Final report on analysis of CFRP components		T+22M

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. Remarks

None.

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-012

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-012	Concept study: Cleaning device for wing leading edge	Start Date	01/07/2010
		End Date	31./12/2011

1. CfP Description

A major problem for laminar wing design of aircrafts is the accretion of insect remains on the leading edge.
The height of insect debris should not exceed a height of 100 µm, otherwise the laminar flow is disturbed.

This well known problem is solved in sailplanes (gliders) with a glider cleaning device, but currently not for commercial aircrafts.

Therefore the subject of the CfP is the development of a concept study for a cleaning device for the wing leading edge of a commercial aircraft/bizjet.

The work should focus on a concept that is capable of cleaning the wing leading edges after take-off after leaving the “insect-zone” (up to 500m).

The required study should point out strategies for cleaning devices on aircrafts, especially the modification of the glider device of sailplanes. The cleaning concept has to be compatible with the surface treatment/coating of the leading edge.

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

- Knowledge in the field of surface/material cleaning and/or cleaning devices for gliders
- Experiences in test-conditions for aviation industry

3. Major Deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Collection of cleaning device strategies		31.03.2011
D02	Concept study (report) for a prototype device	Comprehensive study including the modification of the cleaning devices for gliders, the combination with easy to clean coatings and the influences on these, as well as a prototype design for a commercial aircraft	31.12.2011

4. Value of CfP workpackage

The total value of biddings for this work package shall not exceed **€ 40.000,--** **[forty thousand euro]** Please note that VAT is not applicable in the frame of the *CleanSky* program

5. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-013

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-013	Active flow control (AFC) techniques on trailing edge shroud for improved high-lift configurations – design, manufacture and tests.	Start Date	01.07.2010
		End Date	31.12.2012

1. CfP Description

The subject of this Call for Proposal is design, manufacture and testing of high lift devices with integrated flow control actuator techniques into the main wing trailing edge shroud.

A special feature of this shroud is the droop capability of the spoiler(s).
An optimized design has to be explored for the application of the active flow control techniques for the enhancement of the drooped spoiler device and of an optimized setting of the flap and has to be demonstrated on a mid scale model in wind tunnel tests. These tests will be part of other tests with application of active flow control (AFC) techniques on the flap within SFWA.

The objective is to provide different flow control means of continuous and/or pulsed flow control technique on an innovative high-lift flow configuration in order to delay the separation onset on trailing edge device like on a single slotted flap with a drooped spoiler set-up.

Further more the most efficient flow control means has to be implemented in the needed devices of the wind tunnel model requested by another topic, i.e. a constant chord wind tunnel model with different high lift configuration set-ups for conduction of tests in a mid scale wind tunnel facility like Filton LSWT of Airbus and/or DNW-NWB in Brunswick.
The clean wing chord of the available wind tunnel model is 0.60 m with possible sweep angles are 0, 20 and 30 degrees (mid scale 2.5D F15 model) to be applied.
The targeting high lift configurations with active flow control is a slat-less configuration with optimized strongest deployments angles for the flap and optimized drooped spoiler angles with respect to most improvement in camber and therefore aerodynamic performance.

These investigations have to be conducted and are planned for 2011/2012 within SFWA and will deliver reasonable data basis for further exploitation of these flow control means for large scale and high Reynolds number wind tunnel tests.

Further more it has to be ensured by structural integration design studies that implemented flow control technologies esp. within the surface structure of the elements / devices like main wing and spoiler, can be implemented regarding requirements on aircraft level and structural conditions with respect to defined loads cases on the base of given aircraft type. The finally find and selected surface topologies have to feed into the aerodynamic investigations and design of wind tunnel model devices.

The 2.5D mid scale wind tunnel model is designed with respect to geometry called F15 geometry and is delivered with a laminar nose by one SFWA partner and with a turbulent nose by another SFWA partner. The shapes of the spoiler and trailing edge (TE) devices are given as well as the reference settings for the needed high lift configurations without flow control and with flow control applications. However, an optimized setting and deployment angles set-up has to be investigated in this mid scale wind tunnel tests.

In order to provide a suitable and tough planning for this mid scale wind tunnel test with the swept high lift model configuration in Filton LSWT and/or DNW-NWB, it is needed that the applicant will provide in advance the conduction of reasonable pre-tests in their own facility. These pre-test could be conducted on a two-dimensional (2D) set-up a wind tunnel model and preferably by using the same

F15 geometry. (The mid scale 2D F15 model has a clean wing chord of 0.6 m.)

Furthermore it is needed by the applicant to explore the ground effects. This means by using a suitable set-up of a moving belt to perform aerodynamic studies with high lift configurations with highest deployment angles, so that active flow control means realize a re-attachment of the drooped spoiler and flap flow achieving maximum angles of attack.

The results of these ground effects investigations with a moving belt has to be exploited towards the planning of large scale wind tunnel investigations and numerical simulation for flight Reynolds numbers within SFWA.

The combination of active flow control means on the main wing and on the trailing edge shroud device of the drooped spoiler is mandatory. Further more it could be useful to cooperate with another SFWA partner to set-up on the flap also another active flow control technology in order to further enhance the capability of active flow control applications in these pre-tests as well as wrt the conduction of the mid scale wind tunnel test in F-LSWT and/or DNW-NWB.

The delay of separation on a specific configured trailing edge shroud / device of a high lift configuration model has to be demonstrated in these previous test in the own wind tunnel facility on a two-dimensional model of the applicant and in the mid scale wind tunnel test in Filton LSWT of Airbus and/or DNW-NWB in Brunswick on a given mid scale constant chord swept wing wind tunnel model by partners within SFWA.

The range of Mach number for experimental investigation is between Ma=0.15 and 0.25.

Furthermore pressurized air supply and different measurement techniques on the mid scale F15 model are given.
With the conduction of the experimental investigations a detailed analysis of the obtained results are needed, so that for each test campaign a technical report can be delivered by the applicant.
The requirements for the constructions and manufacture of the trailing edge shroud device for the mid scale 2.5D F15 model will be defined by the applicant together with the SFWA partners. Construction and manufacture of trailing edge shroud device including integration and pressure tabs for the 2.5D F15 model will be done by SFWA partners.

The expected maximum length of the proposal is 25 pages

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 actuators in a wind tunnel model, can manufacture devices and testing of systems for flow control applications in wind tunnels.
- The applicant has to have laboratory testing facilities and equipment necessary for actuator specimen operation and initial functional testing.
- The applicant has the capability to use the moving belt techniques in order to provide ground effect investigations.
- The applicant has to show its expertise in structural design, modelling and optimisation.
- The applicant has to provide support for the operation in upper-coordinate tests.
- All tools for a detailed design process 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	01.10.2010
D02	Pre-tests	Previous wind tunnel tests on 2D mid scale W/T model conducted and analysed	15.11.2010
D03	Ground effects	Previous wind tunnel tests on 2D mid scale W/T model with moving belt conducted and analysed	15.12.2010
D04	AFC surface topology	Parametric modelling, design and simulation of AFC surface topologies on main wing and trailing edge shroud device.	01.02.2011
D05	Design 2.5D mid scale tests	Design review incl. numerical predictions and structural concept of application of flow control means for drooped spoiler high lift configuration and review of construction and manufacture requirements of wind tunnel model set-up and model parts	01.04.2011
D06	Ready for mid scale 2.5D tests	Integration of flow control actuator techniques into delivered model devices. Test readiness review.	15.08.2011
D07	2.5D wind tunnel tests conducted and analysed	Final wind tunnel tests with flow control on 2.5D F15 model conducted in F-LSWT and/or DNW-NWB and analysed.	01.12.2011
D08	Exploitation report for large scale model test	Exploitation of all data (incl. numerical data and structural design concepts) and results for preparation of large scale wind tunnel test in a large scale facility like DNW-LLF	15.02.2012
D09	Final report.	Final technical report about results and project closure.	15.12.2012

4. Value of CfP workpackage

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

€ 460.000,--
[four 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	140	260	60	0	0	0

6. Remarks

The applicant will be supported especially in the preparation and conduction phase of the mid scale wind tunnel test(s) in F-LSWT and/or DNW-NWB. The expenses of the wind tunnel test(s) itself will be covered by SFWA.

The wind tunnel test costs for the applicant's own wind tunnel, have to be carried by the applicant.

The applicant has to ensure that the needed actuator subsystems for the conduction of the active flow control techniques integrated in the wind tunnel 2.5D F15 model are available and well implemented wrt wind tunnel facility safety issues. The applicant will get also support for the conduction of the AFC technique in case of pulsed flow control technique esp. on main wing element, which can be also delivered by a partner within SFWA.

The main point of this topic is to use flow control systems / actuators off-the-shelf and to implement these techniques in an efficient way in the needed wind tunnel models for aerodynamic wind tunnel test, in order to prove the active flow control concepts on trailing edge shroud.
The structural design work is a side study, which should ensure that the selected surface topology in the model devices are correctly designed regarding the aerodynamic requirements and the structural design requirements on aircraft level downsized on mid scale wind tunnel model level.
However, capabilities of optimisation and finite element models should be used on aircraft level dimensions. In the beginning of this CfP-project, for this a finite element model based on this F15 geometry will be delivered by a partner within SFWA.

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-SFWA-01-014	Manufacturing of the test set up for gust load alleviation in Onera S3Ch WT facility	Start Date	01/09/2010
		End Date	31/12/2011

1. Topic Description

The subject of this Call for Proposal (CfP) is the manufacturing of the Wind Tunnel (W/T) Test set-up, to be implemented at an ONERA facility. Experiments will be carried out at ONERA's Chalais Meudon Center's S3Ch research W/T (transonic continuous W/T).

This CfP involves the manufacturing of 3 main parts:

1) A gust generator made of at least two 2D wings (fixed on the walls of the W/T). An ONERA hydraulic excitation system will be used to move the whole wings in pitch or to deflect trailing edge control surfaces.
2) A mechanical frame fixed on the test section, insuring the mounting of a 2D W/T model. This mounting system will allow heave and pitch motion of the model.
3) A 2D model equipped with a movable trailing edge control surface and embedded instrumentation. A second part including a movable horizontal tail plane will be added as needed.

The design of the generator is still in progress and aims to define an optimal architecture for the gust generator. An example of the preliminary concept is presented in Figure 1. The dimension of the W/T test section shall be about 0.8 by 0.8 m2, which will provide information about the scale and the size of the 2D wings to be manufactured (i.e. 2D wings for the generator with a 0.1m chord and 0.8m span).

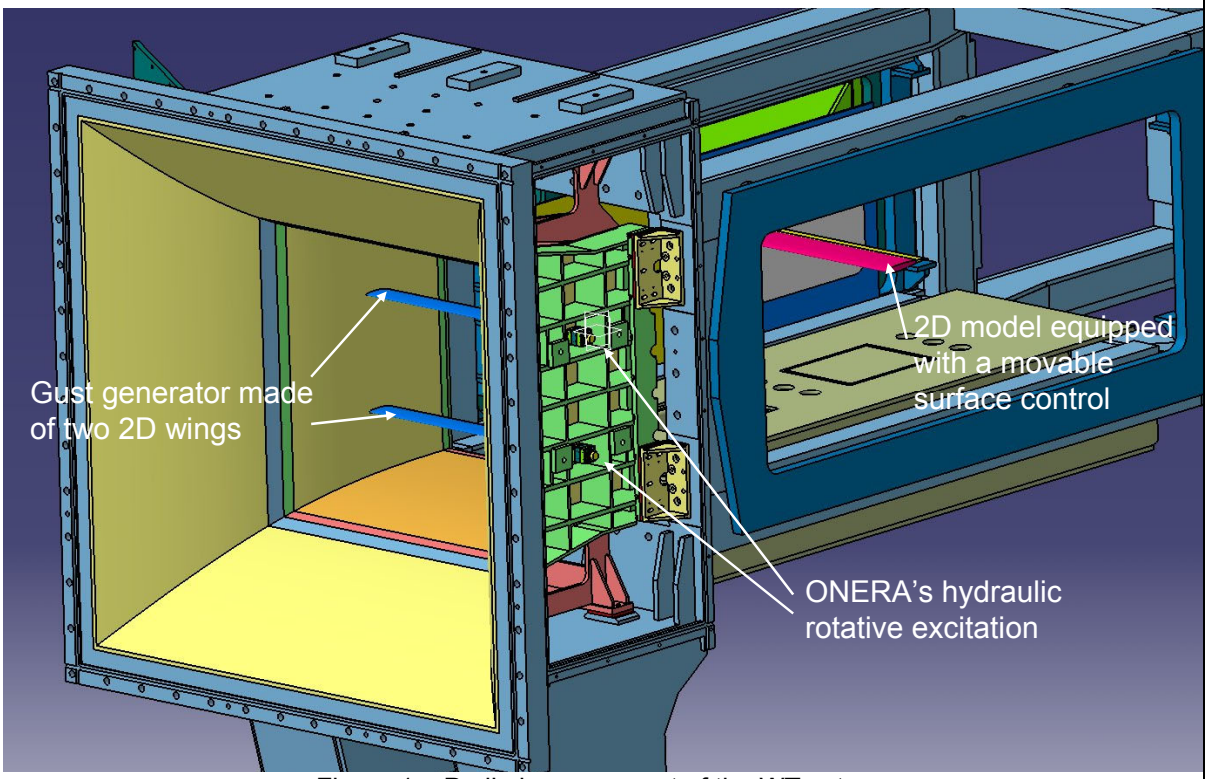


Figure 1 – Preliminary concept of the WT set-up

The applicant shall manufacture all metallic and/or composite parts according to the drawings provided (CAO files). The contract shall include the metrological control of each part and the check for conformity with the CAO requirements. The mounting of every mechanism and the verification of their good functioning shall be included in the contract.

The delivery of the 3 parts could be adapted in accordance with the CAO files provided, the delivery of the gust generator in a first step and the delivery of the model and the mounting system in a second step – Figure 2.

N°	Nom de la tâche
1	**JTI SFWA WP 1.2.4.3**
2	Gust Generator Manufacturing
3	Mounting System of the model
4	2D model (clean configuration)
5	2D model modification (HTTP configuration)

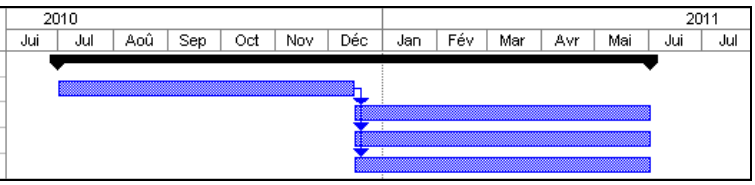


Figure 2 - Gantt Chart / WBS

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

- The applicant shall have an industrial background in the manufacturing of W/T models
- The applicant shall be fully ISO 14001-certified

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D1.2.4-01-01	Generator delivery	Delivery of the generator parts (wings and mounting system)	T0 + 6 months
D1.2.4-01-02	Model delivery	Delivery of the W/T model parts (wing and mounting system)	T0 + 12 months
T0 = Date of signature by the partner			

4. Value of workpackage

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

5. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-015

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-015	Development and test of a fluidic actuator prototype (MEMS type) on aircraft level	Start Date	01.07.2010
		End Date	31.12.2011

1. CfP Description

The subject of this Call for Proposal is the development, design, manufacture and testing of a prototype for a pulsed flow control actuator on aircraft level dimensions based on a Micro-Electro-Mechanical System (MEMS) controlled subsystem.

The principle of the **active flow control (AFC) actuator** is based on MEMS or similar technology involving the use of an electronically controlled valve allowing the provision of a pulsed jet flow on the surface of the device.
The design and construction of the actuator prototype shall take into account industrial purposes for integration in an aircraft as well as flight certification issues.

Integration design work and certification tests are not part of this CfP but constraints linked to these aspects shall be considered for the development of the actuator: temperature range, humidity and salt spray environment, compatibility with aircraft available electrical and air flow power.

The actuator prototype shall be developed according to AFC requirements for leading edge including exit velocity (up to 200-300m/s), actuation frequency (up to 1kHz), adjustable duty cycle (20-80%), exit diameter (around 1 mm), orientation angle, and robustness with regards to flight constraints.

The system performance shall be achieved and demonstrated via individual and combined system mock-up tests (valve response, electrical consumption, energy consumption needs, efficiency of the design).

In addition to the monitoring of system data, the aerodynamic behaviour of the jet flow on aircraft level dimensions should be investigated via local and field measurements within and near the exit of the outlet region (flow visualization). Results shall be analysed and the mock-up with regards to aero system requirements shall be optimised.

Numerical simulations of the inner flow and jet flow of the actuator would be useful as they would allow for the validation of the set-up/design of the mock-up and for the comprehensive simulation of real aircraft conditions.

The result of this CfP topic may influence the overall design of the active flow control system (AFCS) within SFWA work package dedicated to the development of fluidic actuators for aircraft.

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

- The applicant should have a sound research background and understanding of industry needs and expertise in flow control actuator aero and system performance for low speed flow control.
- The applicant must have relevant expertise in MEMS or similar technology design and manufacturing.
- The applicant shall have the capabilities to manufacture mock-ups with respect to dimensions on aircraft level, system support capabilities and equipment necessary for system and aerodynamic measurements / investigations.
- All numerical or experimental tools necessary for a detailed design process should be available at the applicant.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Concept Report	Description of fluidic actuator with respect to performances and conceptual design	01.10.2010
D02	Pre-design analysis	Numerical design and simulations (CDR)	01.02.2011
D03	Actuator prototype Manufacturing	Construction and manufacturing of mock-up of actuator and system needs allocated	01.06.2011
D04	Testing	Testing Tests conducted with regards to design variations and system performances needs and pre-analysed.	01.10.2011
D05	Technical report	Final test data analysis and final reporting	15.12.2011

4. Value of CfP workpackage

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

€ 190.000,--
[four hundred ninety five 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	50	140	0	0	0	0

6. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-016

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-SFWA-01-016	Ultra low power autonomous wireless strain gauge data acquisition unit	End Date	30 Aug 2012
		Start Date	1 Sep 2010

1. Topic Description

This topic is addressing load monitoring technologies in the frame of the work package 'load and inertial sensing technologies' for load and flow control.

Main objective within this Task is to develop an autonomous wireless platform for data logging of strain gauges in order to complement optical fibre measurements. This allows to measure strain in widely distributed pilot points with no cabling and low weight impact.
This platform shall be capable for upgrading to any other sensor technology like e.g. inertial sensing or other health monitoring technologies like Acoustic Emission or guided Lamb Waves.

The task comprises

- Design,
- Manufacturing,
- Testing

of a wireless self-contained platform with dedicated load sensor electronics (inclusive preliminary ground tests). A generic architecture for such a system is shown in Figure 1

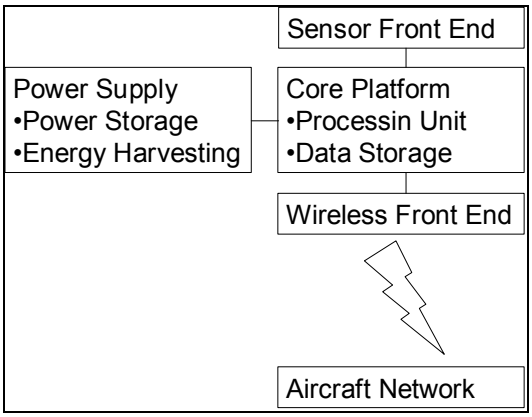


Figure 1

This CfP Topic is divided into 6 Tasks (see Figure 2). Estimates values for the tasks are given in brackets.
Costs are based upon state of the art review and may vary depending on the expertise of the individual applicant.

- Task 1: Platform Architecture (~100k€)
  deals with definition of interfaces, physical and system integration of the processing platform including the data storage devices, the Power supply, the sensor and wireless front end. Further, this task steers all developments within the related tasks and will condense all results in the final reporting.
- Task 2: Network Architecture (~250k€)
  shall develop an ultra low power protocol as well as a network architecture suitable for energy efficient wireless data transmission for both, real time and post processing applications.

- Task 3: Sensor Front End (~80k€)
  deals with the development of technologies for ultra low power sensor front end for sensor read out including data pre-processing with capabilities for e.g. temperature and gauge factor compensation.
- Task 4: Power Supply (~250k€)
  shall develop a low weight, low size power supply delivering sufficient power through the whole aircraft life in the range of up to a few mW. If necessary this can be reralised with a combination of energy storage and harvesting for both, short range and long range aircraft, including a suitable power management in terms of storage, distribution an provision of power.
- Task 5: Ground Test Evaluation (~60k€)
  shall evaluate the prototype for e.g. interferences with other aircraft systems, data transmission range and installation aspects of the system with respect to final modifications for the following flight-test phase.
- Task 6: Flight Test Evaluation (~60k€)
  shall evaluate the results from flight tests phase with respect to measurement performance and reliability of the system under real flight conditions.

Nr.	Vorgangsname
1	**JTI SFWA WP 1.3.6.2**
2	Task 1: Platform Architecture
3	Task 2: Network Architecture
4	Task 3: Sensor Front End
5	Task 4: Power Supply
6	Task 5: Ground Test Evaluation
7	Task 6: Flight Test Evaluation

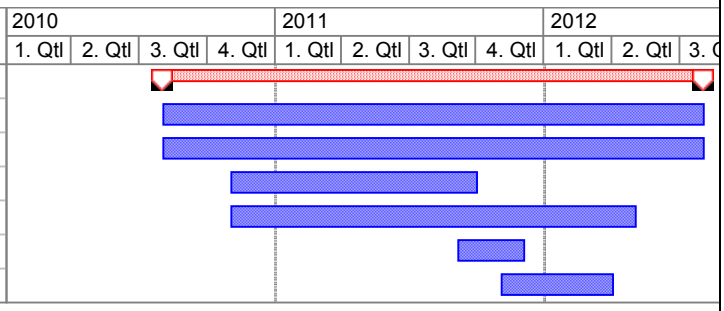


Figure 2: Gantt Chart / WBS - CfP Topic 1.3.6.2

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

The applicant/applicants should have an expertise in

- manufacturing and lay-out of measurement equipment for data acquisition for strain gauges,
- ultra low power electronics and processing,
- energy harvesting,
- network architecture, protocols and wireless data transmission,
- System integration.

The applicant should have a full ISO 9001:2000, ISO 14001:2004 certificate and experiences in developments and qualification according to RTCA and/or MIL standards for aircraft.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.1	Platform architecture, front end interfaces and power consumption requirements	Definition of a platform architecture and initial interface and power consumption requirements for the other tasks	M3
D1.2	Sensor Front End Layout	Provide a preliminary layout for sensor front end	M6
D1.3	Concept for power supply	Provide a preliminary concept for power supply	M6
D1.4	Sensor Front End	Provide sensor front end	M15
D1.5	Power Supply Prototype	Provide a prototype for power supply	M15
D1.6	Data protocols and network architecture	Data protocols and network architecture available	M15
D1.7	Ground test report		M20
D1.8	Flight Test report		M23
D1.9	Final ultra low power autonomous wireless strain gauge data acquisition unit	Provision of final wireless data acquisition unit	M23
D1.10	Final report		M24

4. 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

5. Remarks

N/A

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-SFWA-01-017	Fluidic sensor for the separation detection for low speed in flight – development, design, C&M, and tests.	Start Date	01.07.2010
		End Date	31.05.2013

1. CfP Description

The subject of this Call for Proposal (CfP) is the design, manufacture and qualification of surface-mounted flush flow separation sensors in view of flight test conditions.

The sensor shall be designed; samples manufactured, to be validated in the flow and prepared for system test demonstrations in preparation for large scale wind tunnel (W/T) tests.
The concept for the adequate sensor system architecture needs to be validated experimentally.

The sensor will be designed in such a manner that it reliably detects the flow state and that it delivers signals for control algorithms for closed loop architectures for flow control applications on different wing regions as well as on several flap devices where separation may occur.

The specific *sensor* requirements are aimed at delivering signals which allow a robust, minimal and reliable identification of the necessary parameters for the characterisation of the local flow state.
The specific *design* and construction requirements need to be validated experimentally before the design freeze.
The specific *manufacture* requirements are connected to a high reproducibility, high reliability and low tolerance of the technology.
The specific *system test and test preparation* as well as analysis requirements at this stage are resistance to humidity and temperature variations.

The specific *model integration* and W/T conduction requirements are:

- flush mounting,
- low volume requirements (e.g. miniaturisation) of data acquisition and
- fast pre-processing with regards to time scale for closed loop control algorithm.

Specific *flight certification* issues will be considered and whichever steps have been taken and need to be taken in order to achieve the necessary certification aspects will be presented.

Objectives:

- Sensor development for separation detection towards application and integration in an aircraft;
- System demonstration for active flow control system concept in closed loop architecture; common application with an active flow control system on high-lift device.
- Manufacture of sensor system prototypes.
- Demonstration in a large scale / high Re W/T model test; common application with an active flow control system. Validation of system design.

Technical achievements
Development of a successfully tested sensor system for a closed loop architecture for intelligent separation detection and flow control.

Milestones

- Sensor system concept developed and tested with regards to Technology Readiness Level (TRL) 3
- Sensor system integrated and tested in a large scale W/T model
- Sensor system for optimised high-lift configuration demonstrated with regards to Technology Readiness Level (TRL) 4

The expected maximum length of the proposal is 25 pages

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

The applicant should have an industrial background in sensor design, technological processing, electronics and the integration of sensor systems

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Concept Report	Description of technical sensor concept with key features (size, material, mounts, etc)	30.10.2010
D02	Validation of concept	Experimental validation of sensor front-end in low cost aerodynamic flow experiments.	30.11.2011
D03	System and integration	Measurement system integration, system validation and demonstration in flight.	30.09.2012
D04	Robustness and Reliability of sensor component for AFC application	Prove of technical concept in combination with actuator system on ground (simulation of aero separation conditions).	30.11.2012
D05	Final report	Final assessment of sensor concept and integration concept into aircraft, project closure	30.05.2013

4. Value of CfP workpackage

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

€ 610.000,--

[six hundred ten 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	70	290	190	60	0	0

6. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-018

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-018	Development and test of subsystem of active flow control actuator based on pneumatic principles	Start Date	01.07.2010
		End Date	31.12.2012

1. CfP Description

The subject of this Call for Proposal is development and design as well as manufacture and test of a mock-up for a prototype of a flow control actuator subsystem consisting on several numbers of elements for a high lift trailing edge device.

The single actuator element is based on pneumatic principles of actuation and is designed regarding aircraft level dimensions and simulated space allocations for integration in a trailing edge device of a typical A320-like civil aircraft (narrow body, single aisle and short range aircraft).

The development and design of the flow control actuator subsystem is based on pneumatic principles, so that one actuator element of the subsystem flow control actuator does not use any electronically controlled valve(s). It is allowed, that one complete subsystem i.e. for one flap may be additionally controlled by one i.e. electronic valve.
Furthermore every single element has to meet the performance needs in a specific range of mass flow and fluid pressure of the actuating flow, dimensionless mass flux rate, frequency, velocity of pulsed jet flow and required surface topology with respect to aircraft level targets.
The dimensionless c_μ value is between 0.05% and 2%, the frequency range is between 15 Hz and 300 Hz, the typical surface topology is a rectangular-like shaped slot with the following slot dimensions: between several cm and 0.5 mm, width between 1 mm and 3 mm.
The actuated jet flow velocity is between 70 m/s and 300 m/s.

The above ranges of parameters shall be demonstrated in general using numerical simulations on suitable Reynolds numbers. Selected parameter sets of the investigated configurations shall be used for final demonstration by the mock-up with respect to aircraft scale, which has to be designed, manufactured and demonstrated in a system ground test, and for finally integration into a (very) large scale wind tunnel model.
This mock-up of the flow control actuator shall be investigated with respect to system performance and aerodynamic behaviour in the inner structure of the actuator mock-up, in order to specify the inner flow conditions and, near the exit of the surface of the actuator structure, the aerodynamic behaviour of the pulsed jet flow. Besides the monitoring of the system data the aerodynamic behaviour of the pulsed jet flow shall be investigated via local and field measurements within and near the exit of the surface topology region of the actuator and above of the virtually high-lift device.
Results shall be analyzed and the mock-up with regards to aero system requirements optimized.
Numerical simulations of the inner flow and jet flow of the actuator are needed in order to validate the set-up/design of the mock-up and to simulate further real aircraft flow conditions in simulations with respect to pressurized air supply conditions, as well as for the surface topology design variations of the slot exits with respect to slot width and spanwise segmentation.
Further more a structural concept and optimised structural design has to be explored and simulated. The targets for the optimisation are low weights, high performance and maintenance with respect to integration issues in a civil aircraft.
Furthermore, it is requested that the prototype of this actuator subsystem will be designed, manufactured and delivered for the demonstration on a to be defined, but large scale wind tunnel model within SFWA in order to proof this actuator concept and its system performance on a large scale wind tunnel model with a chord length of the clean wing of at least 1.2m and flap chord of about 30% based on F15 profile geometry.
The expected maximum length of the proposal is 25pages

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

- The applicant should have a sound research background and understanding of industry needs, expertise in flow control actuator aerodynamic and system performance for low speed flow control on industrial high-lift configurations.
- The applicant shall be able to manufacture mock-ups with respect to dimensions on aircraft level and principle demonstration of prototypes, system support capabilities and equipment necessary for system and aerodynamic measurements / investigations.
- The applicant shall have expertise in the field of numerical simulations of high-lift flow control applications in low speed.
- The applicant shall provide support for integration and operation in super-coordinate tests.
- All numerical or experimental tools necessary for a detailed design process must be available to the applicant.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Concept Report	Description of pneumatic actuator performance and conceptual design.	01.10.2010
D02	Pre-design analysis	Numerical design and simulations (CDR)	01.02.2011
D03	Component documents	Construction and manufacturing of mock-up of actuator and system needs allocated.	01.05.2011
D04	Manufacturing	All components available for integration. (TRR)	01.07.2011
D06	Testing	Tests conducted with regards to design variations and system performances needs and pre-analysed.	15.10.2011
D07	Technical report	Final test data analysis and final reporting	15.12.2011
D08	Delivery prototype	Design and manufacture of downsized principle prototype for further aerodynamic W/T tests. Delivery of actuator prototype for large scale W/T test. Documentation.	01.06.2012
D09	Final technical report	Final test data analysis and final reporting	15.12.2012

4. Value of CfP workpackage

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

€ 290.000,--

[two hundred ninety 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	60	160	70	0	0	0

6. Remarks

none

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-019

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-019	Flow Control Actuator System development, manufacture and demonstration for high lift.	Start Date	01.07.2010
		End Date	31.05.2013

1. CfP Description

Subject of this call for proposal is the development, design, manufacturing and qualification of an integrated flow control actuator system, which has to provide means of pulsed pressurized air to interact with high-lift flow around a high lift device like a trailing edge device, during take-off and especially landing; the aim is the delay of separation onset and finally to avoid separation for defined high lift configurations.

The flow control actuator subsystem performance should be oriented at full-scale aircraft requirements with a top-down approach. Scaling and bandwidth can be limited to a specific operation reference in order to obtain an optimized overall design. On aircraft level the actuation frequency for a typical trailing edge device like a single slotted flap can be actuated in a range of 15Hz up to 300 Hz by application of a suitable mass flow in the range of 20 g/m/s up to 300 g/s/m and jet flow velocity in the range of 70 m/s up to 300 m/s (but below the local Mach number).

The Active Flow Control System (AFCS) consists on the subsystem actuator incl. all relevant component designs and/or elements with respect to selected actuator concept, the component control unit for a single flow control actuator, interfaces to sensors, overall control unit of an ensemble of flow control actuators and flight control system, further more the design of the pressurized air supply incl. connections and intakes and the delivery of a integration concept of this AFCS into a main wing/trailing edge device of a typical civil aircraft like A320 aircraft.
Finally an energy concept on aircraft level for the application of the flow control technique for take off and landing of a typical civil aircraft type like Airbus A320 has to be investigated.

The requested pulsed jet flow on the exit of the flow control actuator / surface of the high lift device is working in a specific range of operating parameters as mentioned above like mass flux, pressurized air, frequency of actuations and averaged jet velocity.
In general the AFCS should also be applicable for flow control on slat-less wing leading edge (wing LE box) and main wing sections for low speed / high lift configurations.
The AFCS has to be implemented in the overall active flow control system architecture esp. for integration of an application on high lift TE devices.
The specific design and constructions requirements for AFCS are based on aircraft level application of the system, i.e. material selection, power consumption and communication interfaces take into account existing on-board / to be developed networks and capabilities. Support to aircraft system architecture concepts and integration of the actuator system is expected from the applicant. Major components should be suitable to be integrated locally in the inside of the device structure. The main part of the work for the development, design and simulations of system architecture will be done by SFWA partner(s) within SFWA.

The specific manufacture requirements are based on technology development level, i.e. certification for aircraft integration is not mandatory, but the manufactured prototype has to be designed with respect to certification and integration issues on aircraft level. Industrial grade components can be considered where appropriate.

The specific system ground test and test preparation as well as analysis needs to be performed in major disciplines involved, i.e. computational fluidic component and system design must be followed by numerical and experimental validation and verification on a subsystem level. A laboratory environment is considered as sufficient for functional hardware tests. The final experimental system ground has to proof the system performance of the selected flow control actuator system to meet the requirements of the above mentioned operation regime.

Further more, the selected subsystem of flow control actuator can be downsized, so that this kind of subsystem can be integrated / implemented in high lift device / main wing of a large-scale high lift wind tunnel model.
The dimension of this wind tunnel model / devices will be given within the concept development phase of this AFCS.

The integration of a suitable scaled prototype of AFCS is foreseen in a large-scale wind tunnel model test with a chord length of the clean wing of at least 1.2 m with a flap chord length of about 30% within SFWA. Therefore the AFCS design especially the main subsystem component actuator should be sizable with respect the needed scales for proof of concept in a combined aerodynamic, flow control actuator (subsystem) and structure surface topology large scale wind tunnel model test.

System test demonstration and possibly large (full) scale wind tunnel test demonstration must imply appropriate operational maturity. The actuator should be designed in that manner, that it can be integrated into a closed loop control algorithm for flow control applications in aerodynamic (very) large scale wind tunnel tests (see above) in order to optimize the operation modes of the actuator of the AFCS and to obtain optimized improved high lift performance with active flow control application.

The description of the AFCS concept should reflect beside the technical data other system and economic issues like operability, reliability, maintenance and costs of the possible AFCS system. Finally, the obtained simulation and test results have to be exploited towards aircraft level integration, operation and costs with respect to a to be selected aircraft type..

The expected maximum length of the proposal is 25pages

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

- The applicant should have a sound industrial background in building actuator systems being able to perform the selection, design & integration of actuator, power & control components and subsystems
- The applicant has to have laboratory testing facilities and equipment necessary for actuator specimen operation and initial functional testing
- The applicant has to provide support for actuator system integration & operation in super-ordinate tests
- All numerical or experimental tools for a detailed design process must be available at the applicant.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Concept Report	Description of technical actuator concept with key features (size, material, mounts, etc), energy consumption.	01.12.2010
D02	Pre-design analysis	Numerical actuator components detailed sizing and design, simulation of subsystem models	01.09.2011
D03	Component documents	Specification and drawing ready for procurement / manufacturing of components incl. structural design. (CDR)	01.12.2011
D04	Manufacturing	All components manufacture and available for integration into system ground test rig	01.03.2012
D05	Integration	Pre-assembly and initial operation; single functional tests. (TRR)	01.05.2012
D06	System ground tests	AFC system ground tests incl. environment conditions conducted and system performance analysed, support for integration / operation in tests (structural integrated and aerodynamic tests.)	01.07.2012
D07	Verified prototype and Technical report	System ground test data analysis and final reporting; delivery / demo of verified prototype hardware on aircraft level	15.09.2012
D08	Proof of concept	Support for definition of actuator subsystem for large scale combined aero-system wind tunnel test for aero proof of AFC concept / demonstration	15.10.2012
D09	Final report and exploitation.	Final technical report of AFCS and proof of concept results. Exploitation of results for application / integration on aircraft level.	01.05.2013
D10	Project closure report	Report about project closure – administrative closure and lessons learnt.	31.05.2013

4. Value of CfP workpackage

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

€ 620.000,--

[six hundred twenty 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	70	240	270	40	0	0

6. Remarks

This approach with respect to aircraft scales will aim that an effective and efficient solution can be successfully proved and considered also for later investigations on large scale system ground tests and finally flight tests towards industrialisation.

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-01-020

Topic Description

CfP Nr.	Title		
JTI-CS-2010-1-SFWA-01-020	Structural designs and tests for integration of active flow control concepts on a trailing edge high lift device	Start Date	01.07.2010
		End Date	31.05.2013

1. CfP Description

Subject of this call for proposal topic is development, design including structural analysis and manufacturing of an active flow control system into high lift trailing edge devices.

The reference geometry to be used is the FNG geometry of a high lift wing with high lift leading edge and trailing edge devices. FNG means "**Flight vehicle of Next Generation**" geometry and is background knowledge of Airbus and will be delivered to the applicant at the start of this CfP topic project.
The dimensions of this research FNG high lift wing are similar to the dimensions of an A320 high lift wing.

The structural development and design task includes the screening of materials and manufacturing of surface structures and of structures for integration of selected flow control actuator types into high lift trailing edge devices and connected components including supplies. This means in general structural design of air intakes, pressurized air tubes, supply devices and/or means and actuator chambers including surface outlets with respect to actuator surface topology as structural components. If it is needed for completion of the structural design concepts, some subcomponents could be defined as subsystems, if suitable industrial and already flight certificated technical solutions are available from the shelf. However, the target is to demonstrate a completely integrated structural design concept of a flow control actuator application on a trailing edge device on aircraft level regarding certification rules.
The flow control actuator type supplied with pressurized air, has to be integrated in high lift trailing edge devices of the FNG geometry and main structure. The shapes of the surface outlets of the device structure are in general rectangular or likely shaped geometries. The typical dimension of the outlets are given with a hole diameter / slot width in the range of 1 to 5 mm and a spanwise length of a segment in the range of some centimetres till of about half a meter. The separation distance has to be explored with respect to structural design requirements and/or aerodynamic needs.
For a typical trailing edge device component the structural integration solution has to be simulated using the finite element method on the base of given loads cases and unsteady behaviour of the pressurized airflow on aircraft level.
The following structural integration concepts as enforcements for structure surfaces outlets like slots / holes seems suitable: a) reinforcements of boundary carbon / glass fibre structure and sub-structure within the device, b) hybrid solutions, c) porous structures as enforcements of surface outlets integrated in the device structure.
Here it can be focused on the demonstration of innovative materials like porous micro- or nano-structured materials with inhomogeneous density with respect to aircraft level dimensions.
The specific manufacture requirements are based on certification rules or regulations for aircraft development and existing and possible to be developed manufacturing processes within the time frame of the SFWA project.
Industrial certified components could be considered where appropriate.
For the structural tests different test specimens including material probes, coupons and finally subcomponent specimen as a series of specimens have to be manufactured taking into account industrial manufacturing requirements.
It is expected that for the structural tests two integration concepts will be down-selected and specified. For these selected concepts the needed at average two structural series of specimens per concept will be defined.

With these two series of specimens the structural tests have to be prepared and conducted using a suitable test rig / environment for demonstration of prove of structural design concepts for static and dynamic loads cases and fatigue tests with respect to the given loads cases (outer conditions) and performance of the flow control actuator (inner conditions).
An exemplary test portfolio may contain the following tests. Two static tests, one test with dynamic loads with respect to fatigue loads (fatigue and deformation tests) and one test in conjunction with applied flow control system performance. Here, the system performance of the active flow control featuring pulsed jet flow has to be evaluated with respect to applied fluid pressure, mass flow, temperature, frequency and jet velocity.
For the test preparation as well as the analysis of the test results it is needed that all relevant major contributing disciplines are involved, i.e. the skills of application finite element methods, modelling, optimisation and manufacturing for validation and verification of the structural design concept on component level. An aerospace qualified laboratory environment and experience with aircraft structure applications is considered as sufficient for innovative material sample manufacturing, manufacturing of series of specimen in the given dimensions and structure test capability on industrial level. The optimized and verified surface topologies of the outlets for AFC applications will be used, build-up and investigated in an aerodynamic wind tunnel test using suitable sized wind tunnel models in parallel to the structural design activities of this topic, so that a possible aerodynamic-structure optimisation process is performable.

For this CfP topic the necessary input about design and performance description of the active flow control system as well as a possible prototype of an active flow control actuator will be delivered within SFWA. The AFC system performance will be estimated in the range of up to 300 g/s per 1m span of the high lift device and frequencies in the range up to 350Hz.
The aerodynamic requirements for structural design of AFC outlet surface topologies will be also communicated together within SFWA.
A possible integration of outlet topologies for selected active flow control concepts into wind tunnel models for aerodynamic tests is foreseen to prove the operability for realistic flow conditions and Reynolds numbers by other partners within SFWA.

The expected maximum length of the proposal is 25pages.

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

- The applicant should have a sound research and technology background in aircraft structures and understanding of aircraft industry needs and of aircraft industrial manufacturing processes of innovative material, expertise in aircraft structural design, manufacturing and testing of material coupons and section of components of selected high lift devices.
- The applicant has to have manufacturing capabilities of innovative materials, structural design capabilities, laboratory structural testing facilities and test rigs and equipment necessary for structure designs incl. unsteady loads and fatigue tests.
- All numerical or experimental tools for a detailed design including processing must be available at the applicant.
- The applicant has to provide support for integration & operation in super-coordinate tests.
- The applicant performs the delivery of hardware and the conduction and analysis of tests wrt industrial quality standards.

3. Major deliverables and schedule

Deliverable Reference number	Title	Description (if applicable)	Due date
D01	Concept Report	Description of material and structural design concepts with key features (size, material, mounts, stiffness, maintenance, manufacturing process/concept, repair concept, estimated costs).	01.12.2010
D02	Pre-development and pre-design	Material / structure tests on coupon and detail level and structural design of components and supply on aircraft level wrt sizing and design guidelines.	01.06.2011
D03	Detail design incl. data for manufacturing	Specification and drawing ready for procurement / manufacturing of structural specimen (sections of a fully components on aircraft level) with respect to active flow control system integration place allocation and requirements and outlet / surface topology. (CDR)	01.09.2011
D04	Test specimen manufactured and test rig build-up	Test rig adaptation manufacturing and build-up. Test specimen manufactured and ready for test	01.11.2011
D05	Integration	Assembly and initial tests (TRR)	01.02.2012
D06	Testing	Sample structure tests incl. loads cases conditions and applied system performance needs conducted. Support for integration / operation in tests (system integrated tests for selected structures.) Preliminary test report. Description of mock-up demonstration concept.	01.10.2012
D07	Technical report (analysis and assessment)	Data Analysis of structure ground tests and technical reporting. CDR for mock-up demo.	01.12.2012
D08	Mock-up demo	Mock-up of integrated flow control actuator into manufactured structure device as a spanwise section of a trailing edge device component on aircraft level demonstrated.	01.04.2013
D09	Final report and project closure	Delivery of final technical report and exploitation towards large scale structural / system ground tests on aircraft level and project closure	31.05.2013

4. Value of CfP workpackage

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

€ 940.000,--
[nine hundred forty 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	140	370	340	90	0	0

6. Remarks

Just in the beginning of the CfP topic project, together with contributing partners in SFWA, the available structure concepts will be reviewed with respect to aircraft concept targets.

The selected verified materials, structure designs and proved structure concepts will further be tested on component level in SFWA, if these selected structure solutions will achieve the objectives. Here different perimeters have to be identified with respect to certification issues, but also with respect to weights, manufacturing procedures, maintenance and costs, which will have to be analysed and assessed towards aircraft level.

Therefore contributions by the applicant for proof of concept on industrial level are welcome.

The final mock-up of the verified structure design for a selected flow control actuator concept has to demonstrate on an aircraft like component of FNG trailing edge high lift device. It has to be shown that the most efficient structure can be manufactured regarding structural constraints, requirements and industrial purposes, so that the active flow control system (AFCS) can operate and meets the system and aerodynamic performance requirements.

Clean Sky Joint Undertaking
JTI-CS-2010-1-SFWA-02-006

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-SFWA-02-006	Design and manufacture of a ground-based structural / systems demonstrator	Start Date	01.07.2010
		End Date	31.05.2011

1. Topic Description

As part of the Short Range Aircraft (SRA) programme activities to mature a Natural Laminar Flow wing solution for a future transport aircraft it is intended to support the design activities by designing, manufacturing and testing single and/or integrated wing leading edge technologies.

In this Call for Proposal (CfP) we seek innovative design solutions for 5 different **component technologies** (features) that will enable the prime functions of the leading edge assembly.
This study should consider leading edge design solutions in metal, composites (CFRP) or a combination of materials.
The particular 'features' under the remit of this call include the leading edge **structural components** e.g. skins, ribs and high lift kinematic components and **contributing system technologies** e.g. de-ice systems and lightning protection.

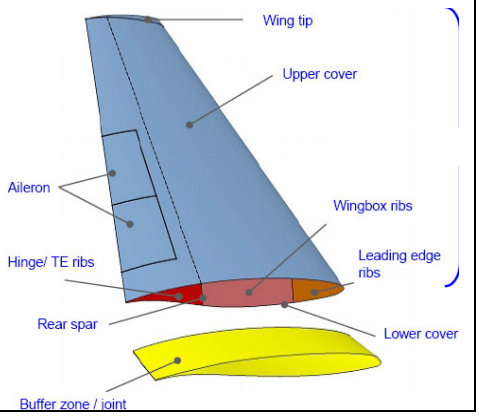
Later on, a 'zonal', demonstrator will integrate system and component 'features' that have been investigated and evaluated at small scale and in isolation.
The design and manufacture of the Zonal Demonstrator will be the subject of further CfPs in 2011 and 2012.
A 'zonal' demonstrator refers to a specific region of the wing with all integrated systems e.g. the leading edge assembly. A 'feature' demonstrator refers to a specific technology that contributes to the zone under study.

Examples of wing 'zones' would be the leading edge assembly, the fixed trailing edge, the wing box etc.
The expected outcome of this CfP will describe the **design and evaluation** of a number of alternative solutions per the following features:

1. Innovative wing leading edge ribs and integrated leading edge cover solutions
2. Innovative Krueger flap kinematic solutions and their integration in to the D-nose
3. Continued investigations on potential Wing Ice Protection System (WIPS) solutions

In addition, it is requested that **strategies and potential solutions** for the following a/c requirements are developed:

4. **Lightning Strike** protection for the leading edge zone
5. Innovative concepts that meet the **Bird Strike** requirements for transport aircraft in the presence of a Krueger flap system



The Short Range Aircraft Conceptual Design Team within the SFWA programme will provide the final applicant with specifications and constraints for each of these features, especially the demanding requirements on surface quality. The achievement of an improved level of surface quality in terms of waviness and roughness when compared to present standards for turbulent wings is expected.
Precise targets for surface waviness and roughness will be specified during the negotiation phase when any changes to the proposed programme can de discussed and agreed. The

ability to exceed current levels of industry standard for these parameters will need to be addressed within any application.

It is not expected that **all** candidate features will be taken to a **practical** demonstration. However, where it may be necessary to demonstrate the ability of a particular feature solution to meet the specification then such tests would be required within this activity. At a minimum two features should be demonstrated by test. Since surface waviness and roughness are key criteria for investigation, it is expected that allowances should be made for their assessment. The actual technical solutions to be measured will be a milestone to be defined within the programme.

The design solutions from this CfP will be reviewed, down selected and further used by the SFWA Short Range Aircraft Concept Team.

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

- Feature design and integration into an integrated digital mock-up over the range of the systems identified
- Awareness of certification issues related to each of the features.
- Test facilities or access to the same within the necessary time frame.
- Construction of digital models of the solutions and possible extension to dynamic simulation.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Leading edge structural concepts	CAD 3D-models, test reports (when applicable)	December 2010
D2	Krueger kinematic system options	CAD 3D-models, test reports (when applicable)	December 2010
D3	WIPS options	CAD 3D-models, test reports (when applicable)	May 2011
D4	Lightning strike protection options	Technical description report	May 2011
D5	Bird strike tolerance options	Technical description report	May 2011

4. 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

5. Remarks

Surface tolerance criteria and system performance targets will be specified by the SFWA Short Range Aircraft Concept Team (SFWA WP2.1) during the negotiation phase. All applicants should be aware should be aware that the tolerances on surface waviness and roughness are likely to be more demanding than present industry standards.
Test and evaluation output should be sufficient to support both a Design Review process and a rigorous TRL gate review as part of this programme. Hence the need for **quantitative** assessment of the surface waviness and roughness qualities of any proposed solutions.
The emphasis must be on the development of **innovative solutions** to the specified features. Any uncertainties or risks associated with specific features must be identified within this activity.
Applicants may form a Consortium to ensure that all five technical aspects receive an appropriate level of attention. Where other Partners cannot be confirmed then potential subcontract arrangements may be acceptable. The SFWA Short Range Aircraft Concept Team consists of several partners within the SFWA consortium.

Clean Sky - Systems for Green Operations

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	**8**	**3.545.000**	**2.658.750**
JTI-CS-SGO-01	*Area-01 - Definition of Aircraft Solutions and explotation strategies*			
JTI-CS-SGO-02	*Area-02 - Management of Aircraft Energy*		**3.245.000**	
JTI-CS-2010-1-SGO-02-012	Saber Electrical Benchmark		200.000	
JTI-CS-2010-1-SGO-02-013	Test Bench for global cooling solutions validation		500.000	
JTI-CS-2010-1-SGO-02-014	Construction of evaluation Power Modules (10) to a given design		175.000	
JTI-CS-2010-1-SGO-02-015	Current return simulation (methodology & tool)		300.000	
JTI-CS-2010-1-SGO-02-016	Thermal exchange modeling and power optimization		500.000	
JTI-CS-2010-1-SGO-02-017	Integration study of Electro-thermal and Electro-mechanical Ice Protection devices in an A320 slat.		370.000	
JTI-CS-2010-1-SGO-02-018	Design, manufacturing, integration and validation of AFD function		1.200.000	
JTI-CS-SGO-03	*Area-03 - Management of Trajectory and Mission*		**300.000**	
JTI-CS-2010-1-SGO-03-007	Parametric optimisation techniques for on-board trajectory shaping under constraints		300.000	
JTI-CS-SGO-04	*Area-04 - Aircraft Demonstrators*			
JTI-CS-SGO-05	*Area-05 - Aircraft-level assessment and exploitation*			

Clean Sky Joint Undertaking
JTI-CS-2010-1-SGO-02-012

Topic description

CfP Nbr	Title		
JTI-CS-2010-1-SGO-02-012	Saber Electrical Benchmark	**End date**	31.12.2011
		Start date	01.07.2010

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 the *V&V (Verification & Validation)* process of future more electric aircraft systems Saber by Synopsys Inc has been identified to have capabilities to build up a standardised modelling process. For the feasibility analysis to be performed, a benchmark will be stated with a network stability and power quality V&V study which is representative of a realistic electrical systems design process. On the basis of the result from the test case, the feasibility assessment against predefined criteria will be carried out.

The Systems for Green Operations ITD is looking for a Saber simulation specialist to become a partner of the consortium for implementation of the Saber benchmark problem.

The task of the new partner is to implement the benchmark with Saber and to figure out the capabilities, advantages, drawbacks, and limitations of this software in the aircraft electric system V&V process. The results of the V&V study have to be evaluated w.r.t. the predefined criteria, such that a final feasibility assessment can be easily performed by consortium partners.

2. Scope of work

A basic electrical architecture test case will be defined by an aircraft manufacturer that allows to assess the Saber simulation environment w.r.t. the following evaluation criteria:

- model library & description
- functional & behavioural levels
- implementation ergonomics
- integration robustness
- algorithm compatibility / convergence
- calculation speed
- solver parameters & features
- analysis toolbox & graphical tools
- simulation automation model calibration, parameter optimization
- interoperability with other programmes (e.g. Scade, Simulink..)
- features for real-time simulation and HIL (Hardware in the Loop)
- business aspects
- etc.

The new partner(s) will:

- Develop and integrate Saber models for the given basic electrical architecture test case. Two different levels of detail have to be implemented: functional models for large time frame analysis, such as power flow and network stability analysis, and behavioral models for accurate power quality analysis.
- Run Saber simulations for the two levels of detail and perform the specified network stability and power quality analyses.
- Correlate simulation results with given reference simulation results or given experimental results (if available).
- Evaluate the given criteria from implementation of the benchmark and from running the specified simulation and analysis tasks.
- Provide documentation of the benchmark implementation.
- Compile lessons learnt.
- Provide recommendations on simulation tools.

3. Type of work

The task of the new partner is to implement the benchmark with Saber and to figure out the capabilities, advantages, drawbacks, and limitations of this software in the aircraft electric system V&V process. The results of the V&V study have to be evaluated w.r.t. the predefined criteria, such that a final feasibility assessment can be easily performed by consortium partners.

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

Knowledge on the State-of-the-Art modelling and simulation technologies in Saber. Due to the tight schedule of the requested activity, the proved expertise of the applicants in the concerned technological field will be a key factor of selection. Experience in integrating Saber models from equipment suppliers in a large electrical network simulation would be of great benefit. The answer to this call for proposal must include a detailed description of the experience in the design and integration process of aircraft electric systems using Saber and latest projects closely cooperated with aircraft manufacturers.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Benchmark implementation consisting of model library, integration models, analyses setups	Software	T_0 + 9 months
D2	Simulation and analyses results and report	Data and Technical report	T_0 + 15 months
D3	Criteria evaluation and recommendation report	Technical report	T_0 + 18 months

6. 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:

200,000.-- € (VAT not applicable)

[two hundred thousand euro]

Awards between 50% and 75% of this value may be made by the Clean Sky Joint Undertaking.

7. Remarks

Only if applicable.

Clean Sky Joint Undertaking
JTI-CS-2010-1-SGO-02-013

Topic Description

CfP topic number	Title		
JTI-CS-2010-1-SGO-02-013	Test Bench for global cooling solutions validation	**Start date**	*01/05/2010*
		End date	*31/12/2012*

1. Background

The current trends towards more electrical aircrafts as well as more complex architectures of engines increase the cooling requirements. Furthermore, the access to heat sinks is more and more limited for technical and airworthiness reasons. The cooling system becomes then an enabling technology for future generation aircrafts. The cooling architectures and technologies that have been long time inherited from past engines become now critical and have to be rethought from scratch. In order to test cooling technologies and architectures, a test bench is required. A pre-existing test bench will have to be adapted to allow these tests to take place.

2. Scope of work

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

Design and Modify test bench to allow Liquid-Liquid Heat Exchanger engineering, qualification and certification tests.

Based on SGO Member's functional specification, the partner will design, manufacture, install the test bench in one of SGO Members facilities and train personnel.

The project is splitted in 4 major phases

1. Design
2. Purchase of parts
3. Installation
4. Training

The test rig will allow the test of liquid and air channels heat exchangers

1. Heat Transfer Performance test
2. DP test
3. Decongealing test
4. Valve Opening and closure times, Valve DP
5. Thermal Cycling

The different aeronautic fluids can be used (fuel, oils, air, ..)

The existing test rig has capacity to test air-liquid heat exchanger.

The test rig will have to allow the test liquid-liquid heat exchanger. The switch from air-liquid to liquid-liquid heat exchanger has to be straightforward.

The partner will have to add at least 1 “liquid loop”. Each loop having motor-pumps (10.000l/h, 50 bars), heater-cooler (200kW), flowmeter, temperature and pressure sensors, tank, air-oil mixture housing. Each loop has to be able to be filled and used with the different fluids for different tests. Supplementary liquid loops allowing to test mutliple liquid heat exchanger will make this test bench innovative. The manufacturing of supplementary “liquid loop” is thus a key factor for the choice of the partner.

Another innovation of interest is about the cost of operation of the test bench. Any mature technology reducing the cost of operation of the test bench (like energy recycling) is an advantage.

The partner will have to ensure that the test bench is conform to CE reguations and certified by authorised organisms after the modification.

The topic manager is and remains proprietary of the test bench hardware.

The test rig modification will have to:

1. Comply with the existing test bench (acquisition, …)
2. Allow the addition of air and/or liquid loops
3. Allow the addition of sensors and/or controls
4. Allow the upgrade of the control and acquisition system by a SGO ITD Member personnel

3. Type of work

The work consists in:

- design of a test bench
- purchase of parts
- delivery of the test bench hardware
- training

Management requirements are the following:

Organisation

- The partner shall maintain a single point contact who is responsible for all programmatic aspects of this partnership.
- The partner shall nominate a team dedicated to the project and convey to the Topic 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 Topic 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 Topic Manager (at SGO ITD member 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 partnership.
- 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.

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

- Extensive experience in the field of industrial test bench design and manufacturing is mandatory.
- Experience in test benches for aeronautic fluids and particularly fuel is a key factor
- ISO qualification for the design and manufacturing of industrial test benches is mandatory
- Succession of full autonomy and on-site collaborative work periods is required.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Test Rig Modification Review		01/07/2010
D2	Review before test rig modification		01/09/2010
D3	Reception of the test rig modification and documentation		01/11/2010
D4	Training completed		01/12/2010

6. 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:

500,000.-- € (VAT not applicable)

[five hundred thousand euro]

Awards between 50% and 75% of this value may be made by the Clean Sky Joint Undertaking.

7. Remarks

None

Clean Sky Joint Undertaking
JTI-CS-2010-1-SGO-02-014

Topic description

CfP Nbr	Title		
JTI-CS-2010-1-SGO-02-014	Construction of evaluation Power Modules (10) to a given design	**End date**	August 2012
		Start date	September 2010

1. Background

This activity within WP2.3.1 of SGO is concerned with the design, fabrication and evaluation of planar, or sandwich, module technologies for a high-temperature power electronics module. The work package consortium will deliver a liquid-cooled, 10kW Silicon Carbide-based power converter with a 4-leg topology. A non-hermetic technology is anticipated with a nominal ambient temperature range of -60°C to +200°C. Planar/sandwich packages have no bond wires, can be cooled from both sides delivering improved thermal performance and can be optimised to give exceptionally low parasitic inductance. Although potentially attractive, the assembly of such structures has historically proved complex and costly, involving a large number of piece parts and assembly processes.

Key targets of the work therefore include techniques to reduce the cost and complexity of both the substrate and assembly process. The consortium is seeking a partner who can contribute to our targets as detailed below.

2. Scope of work

1) Design study:

Prepare a fully justified mechanical and thermal design for the planar module assembly process and provide predictions of in-service life under prospective in-service conditions.

2) Technologies for planar module substrate fabrication:

Establish rapid prototyping and volume manufacturing technologies to realise contact features and interconnect posts on DBC (Direct Bond Copper) or AMB (Active Metal Bonding) substrates. Target minimum feature size is 0.3 mm x 0.3 mm with a height of at least 0.5 mm. Materials, coplanarity and compliance to suit the chosen assembly process based on design study 1) and in service requirements.

3) Cost-effective manufacturing route:

Establish a manufacturing process, employing diffusion soldering, to assemble planar modules using the substrates developed in 1) and a minimum of additional piece parts and processes. The maximum allowable assembly temperature is 300°C.

3. Type of work

1) Design study:

A mixture of thermal and mechanical simulation will be required to establish the feasibility of the proposed substrate and module assembly. Application of physics of failure models will be required to assess end of life under prospective in-service conditions.

2) Technologies for sandwich substrate fabrication:

Investigate alternatives to substrate etch processes including (for example) electroplating and Direct Metal Laser Sintering (DMLS) to realise features for top contacts and interconnect posts. A significant challenge here will be maintenance of co-planarity of the layered assembly so controlled compliance is expected to be essential to ensure reproducible assembly.

2) Cost-effective manufacturing route:

Establish a low-temperature diffusion soldering process, to achieve thin, well filled joints, with a carefully controlled bond-line thickness at bonding temperatures below 300°C. Develop a manufacturing process employing diffusion soldering that can be applied to assemble the planar module with the minimum of process operations and piece parts.

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

The successful partner will have expertise and capability in rapid prototyping, electroforming and/or other additive processes applicable to the electronics industry. Experience in the application of thermal and mechanical co-design is essential as is knowledge of physics-of-failure-based reliability design. The partner will be skilled in the application of diffusion soldering and encapsulation to power electronic devices and modules. The partner will include a power module manufacturer equipped and resourced to provide the type and number of modules required for programme evaluation.

Finally, the partner will be able to demonstrate an established track record in working with industry and academia on power module technologies for aerospace applications.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Detailed substrate and process design	Fully justified design including mechanical, thermal and life models	December 2010
D2	Substrate technology delivered	Samples of substrates to agreed specification available	June 2011
D3	Assembly technology delivered	Samples of assembled planar modules available	September 2011
D4	Prototypes	Planar modules for 10 off converter assemblies delivered	April 2012

6. 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:

200,000.-- € (VAT not applicable)

[two hundred thousand euro]

Awards between 50% and 75% of this value may be made by the Clean Sky Joint Undertaking.

7. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-SGO-02-015

Topic description

CfP Nbr	Title		
JTI-CS-2010-1-SGO-02-015	Current return simulation (methodology and tools)	End date	30.06.2011
		Start date	01.06.2010

1. Background

Composite materials such as CFRP (Carbon Fiber Reinforced Plastic) used in the design of aircraft in place of traditional metallic structures and skin do not have the same electrical properties as metallic material.

So the design of these new aircrafts has to include a new electrical network to ensure a number of electrical functions such as current of return for equipments, protection against electrical hazards, potential reference for the systems, lightning protection, etc… This network has been named ESN (Electrical Structural Network) on the new A350 and CRN (Current Return Network) on the new B787.

Unlike traditional metallic aircrafts, the impedance of this network cannot be considered as negligible. It participates to the voltage drop to be taken into account for the sizing of the power lines (supply and return lines) connected to the equipment terminals. These power lines are part of the EWIS (Electrical Wiring Interconnection System - The definition of EWIS is provided in EASA CS25 subpart H).

SGO ITD aims to optimize the EWIS. Thus methods and tools simulating impedances of this new network are necessary to perform EWIS optimization.

2. Scope of work

The call for proposal aims to select a partner that will be in charge of the development of a methodology and tools to perform a model of the electrical network used on composite aircraft for electrical current return function. This network will be called ALEEN (ALmost Equipotential Electrical Network) in the description.

The first step will consist in the development of a method to determine the equivalent impedance model of ALEEN (from DC to 2 kHz). The geometry and the material properties of ALEEN will be provided through a CAD tool.

The EWIS network will be taken into account to determine the non DC model. The EWIS network definition could be rough (space reservation only for example) or detailed (EWIS routes). PEEC (partial element equivalent circuit) type method is one method identified by Labinal to obtain the model. Measured impedance values of the ALEEN network could be additional input data. Validation of the method through a measurement on a mock up will be performed by Labinal.

The second step will consist in the development of a tool to create a simplified model providing the equivalent impedance for the EWIS interconnection points to ALEEN.

The third step will consist in the development of an interface between this simplified model and an electrical design tool to provide the impedance between 2 interconnection points of the EWIS. A first application will be for example the impedances between the point of regulation and any ground points of the EWIS.

3. Type of work

The selected partner shall deliver a methodology and a software tool.

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

Specialization in the field of electrical engineering and expertise in electrical simulation software tool.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Description of the method and justification		31.12.2010
D2	Tool and ALEEN Models		30.06.2011
D3	Interface to electrical database		30.06.2011

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:

300,000.-- € (VAT not applicable)

[three hundred thousand euro]

Awards between 50% and 75% of this value may be made by the Clean Sky Joint Undertaking.

Remarks

Only if applicable.

Clean Sky Joint Undertaking
JTI-CS-2010-1-SGO-02-016

Topic description

CfP Nbr	Title		
JTI-CS-2010-1-SGO-02-016	**Thermal exchange modeling and power optimization** (Development of a Modelica Library for aircraft air conditioning & thermal management architecture modelling)	End date	05.07.2013
		Start date	03.07.2010

1. Background

In the frame of Clean Sky SGO ITD, a member is developing an electrical driven air system enabling both air conditioning and thermal loads management. A complete modelling study will be carried out to optimize and validate the performance of such architectures. Therefore, Dymola models will be developed and delivered following defined SGO modelling process. This implies the development of a Modelica library (Dymola compatible) focused on aircraft air conditioning and thermal management architecture and components.

2. Scope of work

This call for proposal aims to select a partner that will be in charge of the development of a library to model complex aircraft thermal management system mixing air conditioning pack, vapour cycle, liquid loop and electrical turbomachine technologies. These models mainly focus on thermodynamic and global power exchange and not on accurate electric transient phenomena.

The library should contain all required components to model the following systems:

- Vapour cycle systems, i.e. valves, heat exchangers (liquid-2phases, 2phases-2phases and air-2phases), refrigerant compressor
- Air cycle systems, i.e. air compressors, turbines, air-air heat exchangers, water extractor and water sprayer, fan, jet pump, valve, air scoop, electrical fan
- Liquid loops, cold distribution system respectively, i.e. tank, air-liquid heat exchanger, pump, valve and piping
- Electrical turbo-machines subsystem mixing compressor, turbine, pump, vapour cycle compressor, electrical motor, bearings
- Aircraft cabin and air distribution system, i.e. ducts, mixing chamber, outflow valves, simplified cabin flow, cabin thermal behaviour including 3D considerations (Modelica modelling or CFD tool coupling) in order to optimize cooling/heating distribution efficiency
- System control capability

Even if partially based on available standard library, this implies major structure development in order to comply with following requirements:

- Enable data exchange between multi-physic components of the architecture (pneumatic, electric, thermal, mechanical)
- Multilevel modelling for each component in order to adapt modelling accuracy for each system development phase (predesign, steady state performance, system dynamic control, HIL)
- Develop the possibility to combine the library with external tool (Simulink) for system control development
- Integration of developed library within the SGO member existing tool process (link the library to refrigerant fluid & humid air properties calculation hometool for instance)
- Object oriented library development enabling future efficient improvement
- Portable library to be independent from a specific simulation platform

The library will be tested through single and full integrated models to validate compliance with each specified requirement.

The member thermal management demonstrator, tested in the frame of ITD SGO, will be used to validate library performance except cabin distribution 3D model which will need supplier specific tests.

3. Type of work

Partner will have to lead the development of a library to model the performance of air conditioning & thermal management systems and will be in charge of experimental tests for 3D performance validation in cabin area.

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

- using object oriented physical model library development on Modelica (Dymola compatible)
- modelling of complex cooling and/or air conditioning system in aerospace field including mixed vapour cycle and liquid loop technology
- model performance validation through experimental tests

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Modelica library and validation models – phase 1	• Modelica library (Dymola compatible) for steady state modelling of aircraft air conditioning and thermal management system • Steady state validation models	05.07.2011
D2	Modelica library and validation models – phase 2	Modelica library (Dymola compatible) for dynamic modelling of aircraft air conditioning and thermal management system. Dynamic validation models	05.07.2012
D3	Optimized Modelica library	Complete Modelica library (Dymola compatible) adapted to the SGO member tools process	05.07.2013

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:

500,000.-- € (VAT not applicable)

[five hundred thousand euro]

Awards between 50% and 75% of this value may be made by the Clean Sky Joint Undertaking.

7. Remarks

Only if applicable.

Clean Sky Joint Undertaking
JTI-CS-2010-1-SGO-02-017

Topic description

CfP Nbr	Title		
JTI-CS-2010-1-SGO-02-017	Development of a slat with integrated electrical deicers for Icing wind Tunnel tests	**End date**	04.10.2011
		Start date	01.06.2010

1. Background

An associate of SGO ITD is developing new electrical de-icers for aircrafts, based on electro-thermal and electro-expulse technologies.

Such de-icers have to be integrated to the slat structure to give an ice protection assembly, powered through a translating wire bundle from the fixed part of the wing.

For demonstration activities, an assembly based on an existing A320 slat design will be integrated to a mock-up for scale 1 icing wind tunnel tests. This assembly will rely on a fixed harness for power input.

2. Scope of work

Tasks foreseen: (to be discussed with partner)

1) Analysis of SGO associate proposed integration solutions for de-icers and harness (including reparability, maintainability)
2) Local electronics (if any) integration study
3) New slat design / design modifications proposals
4) Integrability tests (bonding tests, mechanical tests, …), solutions validation
5) Slat definition for mock-up integration
6) Slat development and delivery

Inputs:

- AIRBUS Mock-up specifications
- De-icers Interface Document
- Moving harness Definition Document + mechanical interfaces document
- De-icers integration description (proposal)
- De-icers and harness (for demonstration)

Outputs:

-Slat mock up design document
-Industrial analysis document
-Integration validation document

All above work will be conducted through dedicated workshops between the SGO Associate and the supplier with iterative compatibility checking with AIRBUS aircraft requirements.

3. Type of work

Partner will have to lead paper studies for solutions analysis, CAD activities for slat modifications definition and analysis, mechanical simulations for stresses study and sizing, integration tests and test procedure definition, mechanical demonstrator/prototype design and fabrication.

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

Aerospace supplier able to provide aerostructure parts Delivery of a slat assembly with integrated ice protection solution for tests

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Ice protection assembly delivery (AIRBUS facilities)		04.10.2011

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:

370,000.-- € (VAT not applicable)

[three hundred seventy thousand euro]

Awards between 50% and 75% of this value may be made by the Clean Sky Joint Undertaking.

7. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-1-SGO-02-018

Topic description

CfP Nbr	Title		
JTI-CS-2010-1-SGO-02-018	Design, manufacturing, integration and validation of AFD function	End date	30.06.2013
		Start date	03.07.2010

1. Background

Today's experience shows that protections do not cover all failure cases, more specifically arc conditions (low energy events).

The objective of Arc Fault Detection (AFD) is to detect an arc event and to analyze whether it is harmfull or harmless to its environment. Studies are currently in progress to develop and standardize arc fault protection for low voltage networks (115VAC/28VDC), and do not cover new high voltage networks (230VAC/540VDC).

Abbreviations:

EPDS – Electrical Power Distribution System

HW –Hardware

SW – Software

TRL – Technology Readiness Level

2. Scope of work

The objective of this task is to develop, test, and deliver AFD modules adapted to high voltage networks to be integrated into EPDS high voltage switching components (electro-mechanical or solid state), as well as supporting integration of standardized arc fault protection modules on EPDS low voltage switching components.

3. Type of work

Tasks foreseen:

1. Definition:

1.1 Characterisation of an arc in an high voltage (AC, DC) aircraft environment (event condition, effects...)

1.2 Modelling of the arc

1.3 Identification of recommendation to limit arc fault occurence, and of methods to detect arc

1.4 Participation to trade off studies on integration options into switching components

2. Development:

2.1 Development of a detection algorithm

2.2 Module definition & realisation (HW and/or SW)

3. Validation:

3.1 Standalone module validation & testing

3.2 TRL demonstration

4. Integration:

4.1 Support integration & test of AFD function/modules into EPDS switching components

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

Aerospace Circuit Breaker supplier familiar with:
- aerospace low voltage AFD
- AS5692 standard
- aerospace electrical network environment, including EMI, HIRF & lightning

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Arc fault in high voltage aircraft environment study (characterization, detection methods...)		31.12.2010
D2	AFD modules to be integrated into switching components		30.09.2011
D3	AFD module test report (including TRL evidence)		31.12.2011
D4	Technical support to integration & test of AFD function into switching components		30.06.2013

6. Topic value (€)

The total value of this work package shall not exceed:

1,200,000.00--€

[one million two hundred thousand euro]

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

7. Remarks

Only if applicable.

Clean Sky Joint Undertaking
JTI-CS-2010-1-SGO-03-007

Topic description

CfP Nbr	Title		
JTI-CS-2010-1-SGO-03-007	Parametric optimisation software package for trajectory shaping under constraints	End date	01.10.2011
		Start date	01.06.2010

1. Background

The Clean Sky project, Systems for Green Operations ITD, is looking for a supplier of a non linear parametric trajectory optimization software package tool to become a partner of the consortium.

Joint ventures with legal personality and liability can also respond to this topic Call for Proposal.

Introduction : Clean Sky SGO MTM project objectives and context of the topic

The System for Green Operations research consortium of CleanSky aims to demonstrate substantial reductions of environmental impacts in civil commercial mainline, regional aircraft and business jet domains.

The Management of Trajectory and Mission (MTM) branch of the Systems for Green Operations research consortium aims at developing technologies to reduce chemical emissions (CO2 and NOx) and Noise. One of the main field of research considered by MTM to reach these objectives is to optimize in-flight 4D trajectories, including the overall missions profiles, through mathematical optimisation.

Once an optimum trajectory will be found, it will be evaluated against current state of the art route. Simulations will be performed with emissions and noise models to assess the improvement of environmental performance achieved by the trajectory of the aircraft. Since the technologies and systems developed for trajectory and mission optimisation need to be inserted in the overall economical models of the airlines, which influence these operators choices, the operational “cost” of trajectory will also be assessed.

Theoretical context

Optimal control establishes a general theory to the minimization of a performance index and the satisfaction of constraints whether initial, intermediate or final.

The general setting of offline trajectory optimization or on board guidance function is one of a two point boundary value optimal control problem. Indeed initial conditions are either a given state or the current estimated state of the vehicle by the navigation function, final conditions are also partially fixed (position conditions), and generally there are intermediate constraints to be satisfied (mixed position / velocity conditions and/or constraints derived from them). Then the two point boundary value problem occurs during the process of finding the guidance command, and solving for that the differential equations of the flight dynamics under the various constraints, and minimizing at the same time an optimization criterion (time of flight or propellant consumption minimization for instance).

No explicit solutions generally exist for solving the two point boundary value problem (only for very simplified dynamics such a solution may exist).

Note that it is assumed here that the optimisation is with respect to a scalar criterion and that only numerical solutions are sought for (no evaluation of quasi artificial intelligence techniques such as neural networks, genetic algorithms and so on).

There are two classes of methods called direct and indirect for numerically solving optimal control problems :

- The indirect method is based on the calculus of variations and Pontryagin’s minimum principle, and leads to shooting strategies which use Newton’s method to adjust variables to satisfy the boundary conditions. Obtaining solutions using these techniques strongly depend on the initial guess of the costates , especially for optimal control problems. Moreover it is extremely difficult to guess the initial costates that generally have no obvious physical meaning.

- Direct methods for solving optimal control problems are based on discretization of the infinite dimensional problem and transforming it to a finite dimensional non linear programming one. The time horizon is segmented into several subintervals whose endpoints are called nodes. Then the NLP (Non Linear Programming) variables are the values of the states and controls at those nodes. In between these variables are represented by piecewise polynomials. These techniques are known as collocation techniques.

In the last five years, recent advances have put forward the interest of specific collocation techniques known as pseudospectral methods. In such methods, state, control and costate are modelled by Legendre polynomials. The most interesting point is the possibility to rely in such a frame on fast convergence results.

The looked after software data package shall implement these collocation techniques.

2. Scope of work

Description of work

The consortium wishes to enter into partnership with a supplier able to design a solution to these general requirements applicable to software systems.

The new partner will:

- Make an overview of the state of the art of collocation optimisation techniques;
- Make the full definition of the theoretical problem to solve : reduction of the multicriteria problem (fuel consumption, pollutants emission) to a reduced compound cost function, typical trajectory constraints, aircraft dynamics;
- Specify the numerical optimisation techniques applicable to translate the optimal control problem into a parametric optimisation one, and justify the choice of the method;
- Develop a numerical optimisation software package which is an implementation of the defined optimisation technique, at least based on an aircraft dynamics model, emission models and a relative cost model;
- Identify reference aircraft trajectory tests cases and tests means to validate the optimisation method;
- Perform numerical simulations to test the optimisation results.

Technical requirements and constraints

The answer to this call for proposal must include a detailed technical description of the solution with the associated evidence of the expertise and pre-existing know how.

The numerical optimisation software package is expected to :

- be delivered as a software package running on Microsoft Windows XP Operating System preferably;
- run on a current generation PC, and share processing ressources with other applications;
- be delivered with source code;
- be delivered with the tools enabling to perform the production of the executable and the tests of the software.

The partner organization should have the capacity to maintain the software package – i.e. to further adapt, optimize, and produce updated versions.

3. Type of work

Development of a software package, implementing a collocation optimisation technique for aircraft trajectory shaping under constraints.

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

The candidate organization shall have recognized experience in numerical parametric optimisation techniques applied to optimal control problems.

5. Major Deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Problem Definition (PD)	Formal definition of the optimisation problem to solve, including inputs and outputs data contents The content of this document is defined and agreed in cooperation with the topic manager or his appointed representative, through technical workshops. The models for optimisation (e.g.: aircraft dynamics, emissions, and a relative cost) required as inputs from the SGO ITD will be agreed with the topic manager at this stage.	01.08.2010
D2	Overview of state of the art of collocation optimisation techniques (SOA)	Description of the major classes of mathematical and numerical collocation optimisation techniques applicable to the problem.	01.09.2010
D3	Optimisation technique specification document (OTS)	Specification of the parametric optimisation techniques applicable to solve the problem, Specification of the numerical computation method Rationale behind the choice of these methods	01.11.2010
D4	Software package design document (SDD)	Description of the design of the software package which implements the optimisation technique.	01.12.2010
D5	Validation Test Plan (VTP)	Description of tests cases and tests means to validate the software package. This test plan shall include the acceptance tests to perform at the topic manager request.	01.11.2010
D6	Validation Test Report (VTR), Reference tests data files	Description of tests results and conclusions. This deliverable will be accepted through an acceptance review led by the topic manager.	01.04.2011
D7	Software package delivery (V1): • Source code • Software executable for Windows • Software production and tests execution tools • Software version description document • User Manual document (UM) • (if required) Update of previous documents : OTS, SDD, VTP, VTR	Release of a software implementation of the defined numerical optimisation technique.	**Major milestone: 01.05.2011**
D8	Acceptance Test Report (ATR)	Description of the tests performed at the topic manager facility, their results and conclusions. This deliverable will be accepted through an acceptance review led by the topic manager.	01.06.2011
D9	Problem report and model modification request document (PRD)	Compilation and analysis of problem reports and modification requests agreed in cooperation with the topic manager or his appointed representative.	01.07.2011
D10	Software package delivery (V2) : • Source code • Software executable for Windows • Software production and tests	Release of a software package update for problem fixes or evolutions.	01.09.2011

Deliverable	Title	Description (if applicable)	Due date
	execution tools • Software version description document • Update of previous documents : specification, design, test, user manual. • (if required) Update of previous documents : OTS, SDD, VTP, VTR		
D11	Final Acceptance Test Report (ATR-2)	Description of the tests performed at the topic manager facility, their results and conclusions. This deliverable will be accepted through an acceptance review led by the topic manager.	01.10.2011
D12	Software package delivery (V3) : • Source code • Software executable for Windows • Software production and tests execution tools • Software version description document • Update of previous documents : specification, design, test, user manual. (if required) Update of previous documents : OTS, SDD, VTP, VTR	Release of a software package update for problem fixes or evolutions.	01.06.2012 at the latest

Topic value (€)

The total value of 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 programme

7. Remarks

Reporting

Progress reports will be established by the following elements:

- Description of activities performed
- Numerical simulation / Test results technical reports
- Status of the next deliverables and review milestones

Meeting and review policy

- Management & progress meetings shall be periodically planned during all the project to evaluate activities progress, agree on requirements and results 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.
- Review meetings shall materialize the major steps and to state if all the works and documents foreseen for these review have been performed and are acceptable. Each deliverable shall be accepted by a review meeting.

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Identification	ITD - AREA - TOPIC	topics
JTI-CS-TEV	Clean Sky - Technology Evaluator	0

No topics from Technology Evaluator are included in this call.