European Commission
Research Directorates

Call for Proposals:

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

Call Text

Call Identifier

SP1-JTI-CS-2010-05

Index

Document track changes

Page/topic	*Original*	*Correction or modification*
P.30 ECO-01-018		Topic Suspended from this call.
P.61 GRC-03-005		A format error in the diagram which indicated the "subject of this CfP" incorrectly has now been corrected.
p.114 SFWA-03-004		Short Change in text for requirements (under diagram of aircraft)
p.116 SFWA-03-004		Spelling mistake corrected.
		See also the Q&A document in the additional documents section of the call web page on CORDIS for more information

Specialised and technical assistance:

CORDIS help desk http://cordis.europa.eu/guidance/helpdesk/home_en.html

EPSS Help desk support@epss-fp7.org

IPR help desk http://www.ipr-helpdesk.org

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.

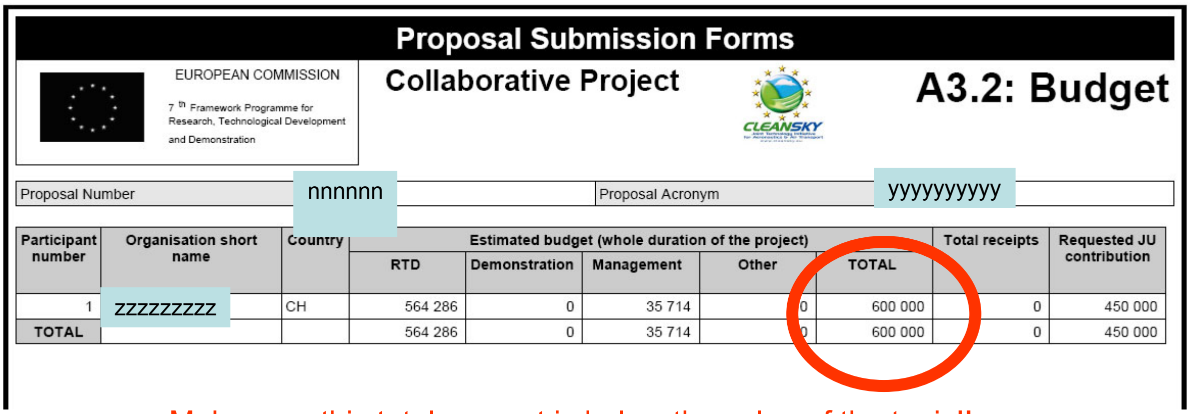
Each Topic fiche addresses the following points:

- Topic manager (not to be published)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.

Recommendation to applicants:


Proposal Submission Forms

EUROPEAN COMMISSION
7 th Framework Programme for Research, Technological Development and Demonstration

Collaborative Project

A3.2: Budget

Proposal Number nnnnnn
Proposal Acronym yyyyyyyyyy

Participant number	Organisation short name	Country	Estimated budget (whole duration of the project)					Total receipts	Requested JU contribution
			RTD	Demonstration	Management	Other	TOTAL		
1	zzzzzzzzz	CH	564 286	0	35 714	0	600 000	0	450 000
TOTAL			564 286	0	35 714	0	600 000	0	450 000

Make sure this total amount is below the value of the topic!!
Better, keep at least 5% margin.
Final amount is to be discussed in the negotiation.

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.

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: 24 September 2010**
- **Call close: 9 December 2010, 17:00**

- Evaluations (indicative): 17-21 January 2010

- Start of negotiations (indicative): 01 February 2011
- Final date for signature of GA by Partner: 18 March 2011
- Final date for signature of GA by Clean Sky JU: 31 March 2011

Recommendation

The applicant is encouraged to apply for a PIC (Participant Identity Code) and to launch the process of validation as early as possible; this will speed up the process of negotiation in the event that your proposal is successful (see http://ec.europa.eu/research/participants/portal/appmanager/participants/portal)

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

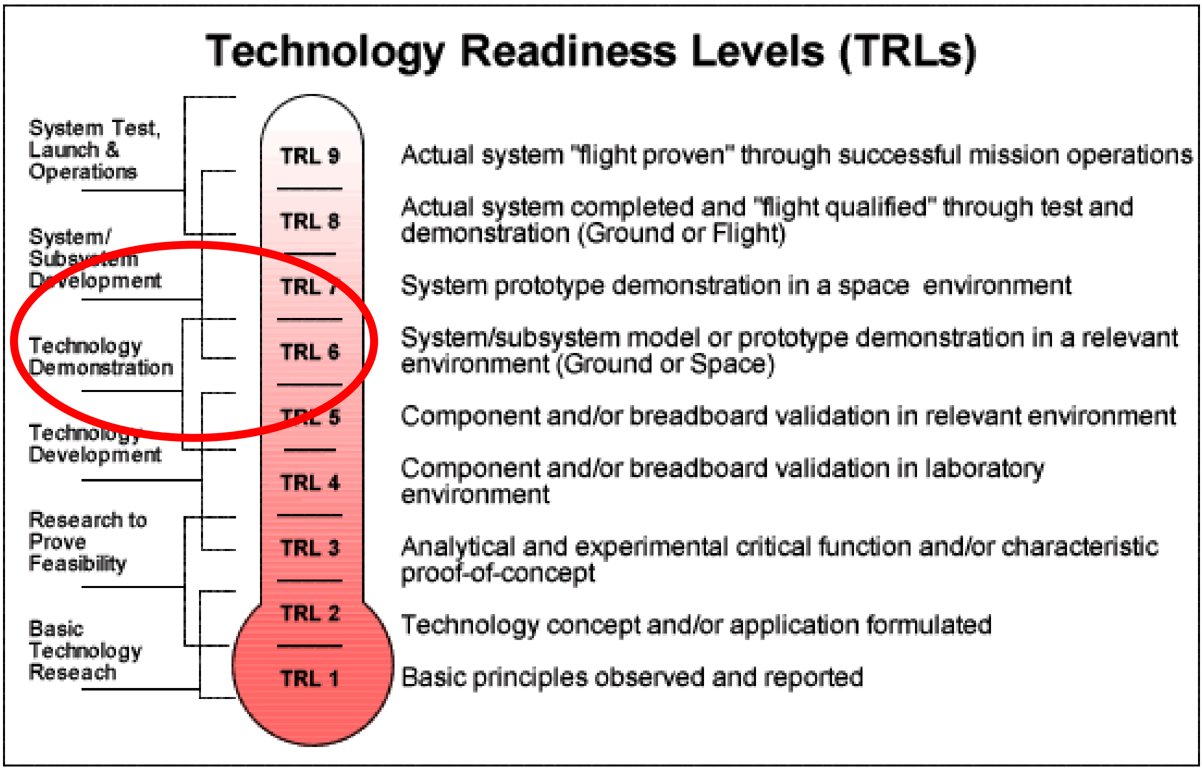
info-call-2010-05@cleansky.eu

Questions received until **12 November 2010** will be considered.

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

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

Reference to TRL:
When applicable or quoted in the text of topics, the applicants should be aware of the definition of Technology Readiness Levels, as per following chart, being TRL 6 the target for Clean Sky for all applicable technologies:



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

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-ECO	**Clean Sky - EcoDesign**	**11**	**5.230.000**	**3.922.500**
JTI-CS-ECO-01	*Area-01 - EDA (Eco-Design for Airframe)*		**3.030.000**	
JTI-CS-2010-5-ECO-01-010	Study of cyanate ester based composites in a high service temperature environment		400.000	
JTI-CS-2010-5-ECO-01-011	Bicarbonate media blasting for paint-varnish removal and dry surface treatment		300.000	
JTI-CS-2010-5-ECO-01-012	Development of more eco-efficient aluminium alloys for aircraft structures		500.000	
JTI-CS-2010-5-ECO-01-013	Development and implementation of conductive coating for Magnesium sheets in a/c		160.000	
JTI-CS-2010-5-ECO-01-014	Infusion system development for primary structure		200.000	
JTI-CS-2010-5-ECO-01-015	Development of advanced preforms for LCM technologies		250.000	
JTI-CS-2010-5-ECO-01-016	Surface mapping to improve reliability of dry treatment on metallic and organic surfaces		250.000	
JTI-CS-2010-5-ECO-01-017	Production of yarns and fabrics based on recycled carbon fibres (CFs).		250.000	
JTI-CS-2010-5-ECO-01-018	Environmental Data Models and Interface development		720.000	
JTI-CS-ECO-02	*Area-02 - EDS (Eco-Design for Systems)*		**2.200.000**	
JTI-CS-2010-5-ECO-02-006	Electrical Test Bench Power Center		700.000	
JTI-CS-2010-5-ECO-02-007	Electrical Test Bench Control System, Instrumentation and Cabling		1.500.000	
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	**2**	**620.000**	**465.000**
JTI-CS-GRA-01	*Area-01 - Low weight configurations*		**170.000**	
JTI-CS-2010-5-GRA-01-034	Design, manufacturing and impact test on selected panels with advanced composite material		170.000	
JTI-CS-GRA-02	*Area-02 - Low noise configurations*		**450.000**	
JTI-CS-2010-5-GRA-02-014	Wing loads control/alleviation system design for advanced regional Turbo-Fan A/C configuration		450.000	
JTI-CS-GRA-03	*Area-03 - All electric aircraft*			
JTI-CS-GRA-04	*Area-04 - Mission and trajectory Management*			
JTI-CS-GRA-05	*Area-05 - New configurations*			
JTI-CS-GRC	**Clean Sky - Green Rotorcraft**	**7**	**11.580.000**	**8.685.000**
JTI-CS-GRC-01	*Area-01 - Innovative Rotor Blades*			
JTI-CS-GRC-02	*Area-02 - Reduced Drag of rotorcraft*			
JTI-CS-GRC-03	*Area-03 - Integration of innovative electrical systems*		**930.000**	
JTI-CS-2010-5-GRC-03-004	Innovative management of energy recovery for reduction of electrical power consumption on fuel consumption		500.000	
JTI-CS-2010-5-GRC-03-005	Adaptation kit design & manufacturing: APU Driving System		430.000	
JTI-CS-GRC-04	*Area-04 - Installation of diesel engines on light helicopters*		**9.950.000**	
JTI-CS-2010-5-GRC-04-003	Optimised Diesel engine design matching a new light helicopter architecture		650.000	
JTI-CS-2010-5-GRC-04-004	Diesel Power-pack Integration on a light helicopter demonstrator		9.300.000	
JTI-CS-GRC-05	*Area-05 - Environmentally friendly flight paths*		**300.000**	
JTI-CS-2010-5-GRC-05-004	Tuning of simplified rotorcraft noise models. Preliminary acoustic measurement test campaign		300.000	
JTI-CS-GRC-06	*Area-06 - Eco Design for Rotorcraft*		**400.000**	
JTI-CS-2010-5-GRC-06-001	Manufacturing of a Thermoplastic Composite Feasibility Article for a Helicopter Door		200.000	
JTI-CS-2010-5-GRC-06-002	Manufacturing of thermoplastic structural demonstrators		200.000	
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	**4**	**5.400.000**	**4.050.000**
JTI-CS-SAGE-01	*Area-01 - Geared Open Rotor*		**0**	
JTI-CS-SAGE-02	*Area-02 - Direct Drive Open Rotor*		**0**	
JTI-CS-SAGE-03	*Area-03 - Large 3-shaft turbofan*		**2.600.000**	
JTI-CS-2010-5-SAGE-03-007	Large 3-shaft Demonstrator – Core Turbomachinery – High Temperature Flexible PCB		600.000	
JTI-CS-2010-5-SAGE-03-008	Large 3-shaft Demonstrator – Structural Surface Cooler development		2.000.000	
JTI-CS-SAGE-04	*Area-04 - Geared Turbofan*		**2.800.000**	
JTI-CS-2010-5-SAGE-04-002	Development of Innovative SLM-Machinery for High Temperature Aero Engine Applications		1.800.000	
JTI-CS-2010-5-SAGE-04-007	Development of Selective Laser Melting (SLM) Simulation tool for Aero Engine applications		1.000.000	
JTI-CS-SAGE-05	*Area-05 - Turboshaft*		**0**	
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	**8**	**3.999.000**	**2.999.250**
JTI-CS-SFWA-01	*Area01 – Smart Wing Technology*		**1.842.000**	
JTI-CS-2010-5-SFWA-01-007	In field surface inspection tool for contamination detection before bonded composite repair		250.000	
JTI-CS-2010-5-SFWA-01-014	Final design and manufacturing of a test set up for the investigation of gust load alleviation		400.000	
JTI-CS-2010-5-SFWA-01-030	Quantification of the degradation of microstructured coatings		200.000	
JTI-CS-2010-5-SFWA-01-031	Assessment of the interaction of a passive and an active load alleviation scheme for a transport aircraft		200.000	
JTI-CS-2010-5-SFWA-01-032	Technology evaluation and manufacturing of microtechnology-based Active Flow Control actuators		300.000	
JTI-CS-2010-5-SFWA-01-033	Numerical Simulation of the Assembly Tolerances for NLF Wings		492.000	
JTI-CS-SFWA-02	*Area02 – New Configuration*			
JTI-CS-SFWA-03	*Area03 – Flight Demonstrators*		**2.157.000**	
JTI-CS-2010-5-SFWA-03-004	A340 Outer Wing Metrology		1.457.000	
JTI-CS-2010-5-SFWA-03-005	Surface quality measurement in flight		700.000	
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	**6**	**3.700.000**	**2.775.000**
JTI-CS-SGO-01	*Area-01 - Definition of Aircraft Solutions and explotation strategies*		**0**	
JTI-CS-SGO-02	*Area-02 - Management of Aircraft Energy*		**550.000**	
JTI-CS-2010-5-SGO-02-027	Simulation and Analysis Tool Development Part I		400.000	
JTI-CS-2010-5-SGO-02-031	Qualification of insulation materials to engine oils		150.000	
JTI-CS-SGO-03	*Area-03 - Management of Trajectory and Mission*		**1.150.000**	
JTI-CS-2010-5-SGO-03-011	Recruitment of qualified flight crew (test, airline) and expenses for tests		250.000	
JTI-CS-2010-5-SGO-03-012	SOG Wheel Actuator development for existing aircraft		650.000	
JTI-CS-2010-5-SGO-03-013	Economical analysis according to business jets operatorsprofile		250.000	
JTI-CS-SGO-04	*Area-04 - Aircraft Demonstrators*		**2.000.000**	
JTI-CS-2010-5-SGO-04-001	Design and manufacture of an aircraft tractor compliant with specifications for Smart Operations on ground		2.000.000	
JTI-CS-SGO-05	*Area-05 - Aircraft-level assessment and exploitation*		**0**	
JTI-CS-TEV	**Clean Sky - Technology Evaluator**	**0**		
		topics	VALUE	FUND
	totals (€)	**38**	**30.529.000**	**22.896.750**

Clean Sky – EcoDesign

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-ECO	**Clean Sky - EcoDesign**	**11**	**5.230.000**	**3.922.500**
JTI-CS-ECO-01	*Area-01 - EDA (Eco-Design for Airframe)*		**3.030.000**	
JTI-CS-2010-5-ECO-01-010	Study of cyanate ester based composites in a high service temperature environment		400.000	
JTI-CS-2010-5-ECO-01-011	Bicarbonate media blasting for paint-varnish removal and dry surface treatment		300.000	
JTI-CS-2010-5-ECO-01-012	Development of more eco-efficient aluminium alloys for aircraft structures		500.000	
JTI-CS-2010-5-ECO-01-013	Development and implementation of conductive coating for Magnesium sheets in a/c		160.000	
JTI-CS-2010-5-ECO-01-014	Infusion system development for primary structure		200.000	
JTI-CS-2010-5-ECO-01-015	Development of advanced preforms for LCM technologies		250.000	
JTI-CS-2010-5-ECO-01-016	Surface mapping to improve reliability of dry treatment on metallic and organic surfaces		250.000	
JTI-CS-2010-5-ECO-01-017	Production of yarns and fabrics based on recycled carbon fibres (CFs).		250.000	
JTI-CS-2010-5-ECO-01-018	Environmental Data Models and Interface development		720.000	
JTI-CS-ECO-02	*Area-02 - EDS (Eco-Design for Systems)*		**2.200.000**	
JTI-CS-2010-5-ECO-02-006	Electrical Test Bench Power Center		700.000	
JTI-CS-2010-5-ECO-02-007	Electrical Test Bench Control System, Instrumentation and Cabling		1.500.000	

CfP topic number	Title		
JTI-CS-2010-5-ECO-01-010	Study of cyanate ester based composites in a high service temperature environment, understanding of phenomena, optimisation	**End date**	*To + 24 Months*
		Start date	*To*

1. Topic Description

Some components of aircrafts or rotorcrafts, are subjected to a complex history of temperature (between -50°C and 250°C in the present case), moisture and other environmental conditions. Most of these components are currently made out of aluminium alloys. Replacing aluminium parts by continuous fibre-reinforced polymers is considered to reduce weight and to avoid surface treatements with CrVI currently applied on aluminium alloys for corrosion protection. Currently available cyanate ester resins reinforced by glass or carbon fibres are good candidates for use in such conditions. Indeed, cyanate ester resins have a glass transition temperature (Tg) which exceed those of epoxy resins, good processability and high resistance to moisture absorption after curing. However the effects of long-term exposure at elevated temperature (200-250°C) on the cyanate ester matrix composite properties has not been studied , the same goes for the effect of long-term exposure in a combined moisture / high temperature atmosphere. This call aims at investigating those aspects.

To this end, the following steps shall be performed by the applicant:

- Selection of material systems, including resins, fibres, reinforcement types and composites, based on the technical requirements (*technical requirements will be given at the beginning of the project by the topic manager).* The supply chain of these materials must be considered as well;
- Definition of manufacturing process for manufacturing composite specimens;
- to propose a test methodology for studying thermal ageing and thermal degradationmechanisms of cyanate ester composites in order to identify and well understand phenomena which appear in service on composite parts subjected to long-term elevated temperature. This methodology shall include accelerated testing.

After this first stage, the effects of these harsh environmental conditions (combined moisture / high temperature atmosphere) on material properties (such as flame retardancy) as well as mechanical properties must be investigated (by carrying out the proposed and agreed test methodology) and understood.

Based on these results, a proposal shall be issued on how to optimise the materials in terms of processability and fulfilment of the requirements. Based on this_proposal, the material systems will need to be further optimised/ newly formulated at a target cost.

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

The applicant (single organization or a consortium) needs to have the following facilities and knowledges:

- Strong knowledge on thermoset resin based composites (knowledge on cyanate ester resins would be an asset)
- Abilty to organise a supply chain of materials (resins, fibres, reinforcements and composites)
- Extensive experience and capabilities for manufacturing thermoset composites and experience in process optimisation
- Extensive experience and capabilities for characterizing cured and uncured resins properties (Tg, DSC, DMA, viscosity, …)
- Extensive experience and capabilities to assess polymer (cyanate) based composite behaviour in extreme thermal environments, including degradation mechanisms
- Extensive experience and capabilities regarding thermo-oxidative environmental (high temperature)

testing (accelerated conditioning capabilities is considered an asset) of mechanical properties and material properties, including flammability testing capabilities.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Benchmarking and selection of 3 to 4 cyanate ester based composite systems(materials selection)	To perform a benchmarking to select materials for 3 to 4 different cyanate ester based material systems.	T0 + 2 Months
D2	Materials screening test methodology	Propose test methods for materials screening, selected in D1	T0 + 3
D3	Preliminary compliance report of selected material systems for testing.	To perform the test program proposed in D2 and give results and conclusions.	T0 + 6
D4	Development of manufacturing process for composite specimens	Definition of method for reproducible resin mixing, cure cycle, required ancilliary materials, tooling, high temperature curing, etc. Based on materials selection on D3.	T0 + 12
D5	Proposal for test methodology for studying the degradation behaviour of cyanate ester based composites	Proposition of a methodology to study degradation of cyanate ester composites during long-term exposure at elevated temperatures,	T0 + 6
D6	Manufacturing of test specimens D5		T0 + 8
D7	Test report	To perform the test program proposed in D5 and give results and conclusions.	T0 + 12
D8	Methodology for studying effect of combined high temperature/moisture atmosphere on cyanate ester composite on mechanical and material properties	Proposition of a methodology to study degradation of cyanate ester resin matrix composites during long-term exposure at elevated temperature in humid atmosphere	T0 + 8
D9	Manufacturing of test specimens D8		T0 + 10
D10	Test report	To perform the test program proposed in D9 and give results and conclusions.	T0 + 16
D11	Compliance report of material systems for technical requirements.	Report including results from D7 and D10. description of requirements compliance and proposal for optimisation (guidelines, roadmaps, etc)	T0 + 18
D12	Optimization of the investigated cyanate ester based materials systems	Formulation or optimisation of the selected material system to fulful the requirements	T0 + 22
D13	Manufacturing of new fibres-reinforced polymer matrix composites	Manufacturing fibres-reinforced polymer matrix composites with the newly formulated materials system	T0 + 24

4. 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 program.

5. Remarks

If applicable

Clean Sky Joint Undertaking
SP1-JTI-CS-2010-05-01-011

CfP topic number	Title		
JTI-CS-2010-5-ECO-01-011	Bicarbonate media blasting for paint-varnish removal and dry surface treatment	End date	*To + 36*
		Start date	*To*

1. Topic Description

Paint removal is critical during aircraft service life as well as treatment at end of life. Up to now aircrafs or cabinets are mainly stripped with toxic chemicals containing halogenated solvent, phenol, chromate. Those toxic chemical stripper are very active and at high level mainteance center are replaced by peroxide stripper. A certain environmental benefit is expected but the ground time is extanded and they required a temperature higher than 23°C to be efficient. In both case chemical strippers cause important swelling of sealant or veneer which are reworked. This step is time consumming, requires a lot of cleaning agent etc.

Face of both toxicological and cos drawbacks of chemical strippers, an alternative shall be proposed to maintenance center.

Today stripping could be carried out by plastic (TypeV) or embedded wheat starch (type VIII) media blasting. However those two processes suffer important drawbacks:

Type V: create compressive stress at the surface. Great care shall be taken to worker'training. Stripping is restricted to metallic surfaces having a thickness higher that 1 or 1.2 mm. Difficulty to make selective stripping (layer by layer)

Type VIII: low stripping rate

The objective of this topic is to assess new media capable by an approriate selection of blasting set up to ensure both paint removal and dry surface treatment especially at completion.The process shall be suitable for metallic and composite surface but also on veneer of cabinets

Bicarbonate media (or duplex dry process (Laser+..)) are very promising with respect to these objectives. The foressen advantages are reduction of compressive stresses, reduction ground time, selective stripping..

Cost and schedule compare to chemical processes shall be addressed in the proposal.

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

Applicants shall demonstrated the following skills:

*Mechanical stress measurement after treatment

*Knowledge on nozzle improvement

*Bicarbonate media and derivatives

*Media blasting process set up

*Previous work on aeronautical paint and varnish system (paint for air frames and varnish for cabinet)

*Good knowledge of aerospace requirements for selective stripping, full paint removal and surface treatment

Equipment requested for the research shall be:

*Media blasting tools (Blasting, waste treatment, automat)

*Stress measurement

*repainting facilities

*Micrography

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Preliminary assessment. Feasibility study on painted parts (metallic:composite) and varnish	Demonstrator/ report+photos Compressive stress on Al alloy Stripping rate vs protection scheme and substrate Influence on sharp edges Influence on wire mesh and fiber Cleanability Stability of the media vs %RH and Temperature	To + 6
D2	Process improvement loops: Duplex media, nature of nozzle, blasting angle, pressure, particule size and shape	Demonstrator/ report	To + 12
D3	Definition of process window regarding defined objectives: *Paint removal *Varnish removal *Surface treatment	Report	To + 18
D4	Environmental analysis/ cost	Report	To + 20
D5	Implementation on automate	Demonstrator	To + 24
D6	Assessement vs most relevant tests (SAE MA 4872) Test will be defined by topic manager	Report	To+36

4. Topic value (€)

The total value of this work package shall not exceed:

300k€
[three hundred thousand euro]

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

5. Remarks

If applicable

Topic description

CfP topic number	Title		
JTI-CS-2010-7-ECO-01-012	Development of more eco-efficient aluminium alloys for aircraft structures	End date	*To + 24*
		Start date	*To*

1. Topic Description

One of the current limitations of aluminium-based airframe structures is the use of eco-unfriendly corrosion protection systems. These are currently used to ensure appropriate durability to meet maintenance interval requirements, with specific protection strategies as a function of alloy-temper and location within the airframe. Their replacement by more eco-friendly solutions depends both on the intrinsic corrosion resistance of the aluminium alloys and on the performance of the corresponding protection schemes.

This call focuses on the increase of intrinsic corrosion resistance of Aluminium alloys for structural applications. Regarding the Aluminium alloys intrinsic corrosion resistance, based on sea coast exposure tests in particular, low density Al-Li alloys show better corrosion resistance compared to currently used advanced or conventional 2000 and 7000 alloys. They can contribute to eco-efficient airframe solutions by relaxing the need for eco-unfriendly surface treatments. In addition, obviously, their improved mechanical performance and density contribute to lower CO2 emissions through weight savings.

5000 Aluminium series alloys enhanced by the addition of Lithium are a good candidate for corrosion resistance as well as improved mechanical properties. They offer a synergistic solution to more eco-efficient Aluminium a/c structures.

New state of the art Al-Li and Al-Mg-Sc alloys provide weight reduction, cost reduction and improved efficiency. Evaluation of alloys specific properties as a part of a qualification and certification program is essential to provide a/c application of these alloys, especially in structural parts exposed to fatigue and justified by damage tolerance conditions.

The goal is sheet shaped material between 1.2 to 6mm thick. Preliminary tests show an excellent corrosion resistance. The density of this type of alloy is 2.55, compared to 2.8 for conventional alloys and 2.7 for 2198 and 2050. This represents about 9% weight reduction by density alone. Properties close to 2056, improved 2024, are targeted: Strength to density ratio, dynamic properties, crack propagation rate and corrosion resistance.

The applicant has to furnish:

- Proof of existence in its portfolio of an alloy matching the previous requirements

- Provide at the end of this work a complete data package according to specific aeronautic requirements. The data package will deal with the following issues:

Corrosion : The corrosion performance of the alloy has to be evaluated in standard salt spray tests, sea coast exposure tests, and in relevant situations involving surface protection, which will be specified by OEMs.

Static test : Other properties will be evaluated as well since the real challenge is to combine the corrosion performance with the mechanical performance. Static tests will be performed. Each data point will be based on 5 samples.

Fatigue test : One S-N curve will be performed for each studied case, means along transverse and longitudinal direction, with and without coating,

Damage tolerance behavior : Fatigue crack growth rate will be performed for each studied case. 3 samples by case.

The two main objectives are:

1. To bring one 5000 alloy containing Lithium to an estimated TRL6 level : product defined and properties established in an operationally representative environment.

2. To prove this alloy meets nowadays mechanical requirements and overmatch nowadays corrosion requirements. (2024 and 7075 or others as reference).

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

1. Rich experience in development of Aluminium alloys
2. Industrial world wide company
3. Strong knowledge in aeronautical Aluminium alloys chemical and mechanical properties.
4. Owning one or two references in Aluminium-Lithium-Magnesium alloys at TRL3/4
5. Ability to perform salt spray tests
6. Ability to perform static and dynamic tests
7. Strong experience in aeronautical qualification scheme for Aluminium material.
8. Co-operate with aircraft manufacturer participants in choice and re-design of sections/parts made of conventional Al-alloys, to be replaced by candidate alloy, to minimize weight and corrosion damage.
9. Co-operate with participants in manufacturing the sections/ parts of candidate alloy, with special emphasis on waste management.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Roadmap toward TRL6	Contain the roadmap to reach a defined product in operationally representative environment.	To + 3 Months
D2	Test Program of new Aluminium alloys	Contain accurate description of salt spray test and associated coupons with coating. Accurate description of static and dynamic tests. Fatigue crack growth rate test and S-N tests will be performed. Initial results will be presented.	To + 6 Months
D3	12 months report	Contain bibliography and a status at 12 months. Presentation of fatigue and damage tolerance results as well as static and corrosion performance.	To + 12 Months
D4	Technical report on formability	Prove that the selected alloy can be use as panel.	To + 18 Months
D5	Technical report on machining behaviour	Prove that panel is suitable for structure applications	To + 24 Months
D6	Final report	Contain all results of corrosion tests and mechanical (static and dynamic) tests according to D2. Supply material for testing and demonstrating.	To + 24 Months

4. Topic value (€)

The total value of this work package shall not exceed:

500,000/00 €

[five hundred thousand euro]

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

5. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-5-ECO-01-013

CfP topic number	Title		
JTI-CS-2010-5-ECO-01-013	Development and implementation of conductive coating for Magnesium sheets in a/c	**End date**	*To+24*
		Start date	*To*

1. Topic Description

Introduction

The development of conductive coating on Magnesium sheets will enable the use of Mg parts that will comply to the requirement of electrical bonding throughout the A/C. The requirement is safety driven and is an JAA, FAA requirement to prevent lightening or static electricity damage to the A/C

The objective of this call is to develop a conductive coating for Magnesium to use on aircrafts parts, complying with standard aviation criteria: corrosion resistance and electrical resistivity requirements (5000μOhm/inch^2) and all REACh regulations. Selected demonstrators must be tested to enable installation of Magnesium parts in aircrafts.

The coating will be tested for corrosion resistance according to accepted aviation methods. Mechanical tests shall be carried out to ensure the process does not have any deleterious effects on the Magnesium properties.

Work to be performed by the partners

- Develop an environmentally friendly conductive coating for Magnesium under REACh regulations that can be applied in a serial production line.
- Perform conductivity tests.
- Perform Salt Spray Tests (SST) according to ASTM B-117
- Coating shall be compatible with aviation paint systems.
- Perform paint adhesive tests.
- Perform an environment analysis of the coating production, including: materials to be used, energy used for the process, list of chemicals used in the process and the effect of the price of the coating
- Perform mechanical tests on raw material samples, on coated material samples, on coated material with paint. Fatigue and static properties should be assessed. Base material to be used shall be a Magnesium with specific mechanical properties similar or better than Al 6061, e.g. WE43.
- S-N curves and three static tests will be provided for each studied lot (3) and for each direction (longitudinal and transverse). It means 6 S-N curves and 18 static test results per material and coating.

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

1. Rich experience in development of a wide range of coatings
2. Equipment to develop the conductive coating
3. Familiarity with Magnesium's chemical and mechanical properties
4. Ability to perform salt spray tests according to ASTM's requirements
5. Ability to perform mechanical test as requested and according to ASTM's requirements
6. Familiarity with aviation regulations and requirements
7. Ability to work under all REACh regulations
8. Equipment to perform the coating at pilot level to represent a serial production line

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Methodological presentation and test plan - Document	1. Description of the preliminary solution 2. Description of the tests to be performed, expected results and major milestones	To+3
D2	First results - Technical reports	1. Initial properties (mechanical and chemical) 2. Initial environmental aspects	To+6
D3	Tests: 1. Salt Spray Test (SST) 2. Resistivity 3. Paint adhesive – Technical report	Deliver specimens for comparative SST evaluation 1. Perform SST according to ASTM B-117 report that will include surface properties with pictures, metallographic examination and any if anomalies result from the SST. 2. Perform resistivity tests and apply to a maximum of 5000 $^{\mu ohm}/_{inch}2$ before and 10000 $^{\mu ohm}/_{inch}2$ after the Salt spray test. 3. Perform paint adhesive tests according to specific request.	To+12
D4	Mechanical and corrosion testing – Technical report	Deliver specimens for comparative SST evaluation Perform Static, dynamic, microscopic examination and corrosion test of selected alloys for three lots: 1. Before the implementation of the conductive coating to evaluate the initiate properties. 2. After the implementation of the conductive coating. 3. After the implementation of the conductive coating and painted. Perform a comparison table between the three lots and the results from the SST.	To+18 To+6 To+12 To+18
D5	Environment analysis – Technical report	Estimate the influence of the conductive coating process from all environment aspects including: energy consumption, pollution of gases, process waste, and cost analysis.	To+18
D6	Demonstrator - Final technical report - Reference part	Adopt the conductive coating on a reference part and gather all data to a technical report (mechanical properties, chemical properties, environmental aspects and economic analysis for the process)	To+24

4. Topic value (€)

The total value of this work package shall not exceed:

€ 160,000

(one hundred sixty thousand euro)

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

5. Remarks

The aim is to bring the process to a TRL 6 stage.

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

CfP topic number	Title		
JTI-CS-2010-5-ECO-01-014	Infusion system development for primary structure	**End date**	*To + 18*
		Start date	*To*

1. Topic Description

Objective of the call is to develop and manufacture two flat stiffened skin composite panels, reinforced with J and blade section stringers, to be realized by Resin Film Infusion (RFI) or Liquid Infusion (LI) techniques.

Both manufacturing techniques, in fact, are very promising and are expected to enable:

- the solution of technical problems related to skin/stringer coupling
- the improvements of the environmental impact (e.g. by using low energy curing technology) in the aeronautical industry
- the reduction of the manufacturing costs.

Dry complex composite pre-forms shall also be studied and fabricated to manufacture the skin stiffened panels with the objective to reduce material waste during the fabrication using the material that shall be identified.

The choice of materials and manufacturing technique to be used for the manufacturing of the panels shall be supported by an analysis and by the realization of trials and coupons to investigate the most critical manufacturing aspects.

Material for coupons and panels manufacturing shall have the following minimum requirements: for the durability a T_g (Glass Transition Temperature) > 120° C; the material shall be also suitable for service at temperature between -50 °C e +80 °C and shall have tension and compression strength and module, CAI (Compression After Impact), BVID (Barely Visible Impact Damage) values appropriate for application on aircraft primary structure. Material shall be, preferably, already certified for aeronautical application.

Coupons shall have approximately the following minimum dimensions: size 200 mm X 200 mm, thickness of 2 mm and n. 1 stringers with J or blade section.

Trade-off to select materials and infusion process shall be then carried-out taking into account process feasibility, ecological aspects and costs. The applicant shall be able either to provide the evidence of mechanical characteristics of chosen material or to carry out a minimum number of mechanical tests in order to derive them.

After the optimisation of the selected infusion process parameters, manufacturing of two stiffened skin panels shall be executed using the part geometry that shall be provided to the applicant and the characteristics of the fibre and of the resin system chosen.

The panels configuration shall provide the following approximate minimum requirements: flat panel size: 1m X 1m with a minimum thickness of 2 mm and n. 5 stringers with J and blade section.

The two stiffened panels shall be then subjected to inspection to validate the results of manufacturing activities and chosen manufacturing parameters.

WP	TITLE
WP1	**Trade-off Study**
Task 1.1	Feasibility study and coupons manufacturing plan
Task 1.2	Study of the process parameters and selection of composite and resin materials
Task 1.3	Coupons manufacturing with RFI
Task 1.4	Coupons manufacturing with LI
Task 1.5	Selection of the infusion process and definition of the process parameters
WP2	**Design and Manufacturing**
Task 2.1	Study and manufacturing of dry composite preforms to reduce manufacturing waste
Task 2.2	Optimisation of the selected infusion process parameters
Task 2.3	Two panels manufacturing and inspection using selected materials and process

WP1

The objective of WP1 is to carry out a trade-off between Resin Film Infusion (RFI) and Liquid Infusion (LI) systems in terms of process feasibility, ecological impact and costs. In order to select the materials to be used and the infusion manufacturing process, trials and coupons representative of the panel shall be realised with both RFI and LI systems. The results shall include the evidence of the mechanical characteristics of chosen materials. Such evidence shall come from testing activities on coupons or from analysis of test results already available in the applicant database.
After the trade-off the final process parameters for the selected technology shall be defined.

WP2

The objective of WP2 is to manufacture two flat stiffened skin composite panels reinforced with J and blade section stringers by using the results carried out by WP1. Dry preforms with geometry studied on purpose to minimize waste shall be used to manufacture the panels. Panels shall be subjected to inspection to validate process and materials selected.

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

The applicant shall have a proven ability in the production of aerospace components/materials having high performance and all the relevant production and lab equipments needed for the development of infusion systems.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Technical Report 1	Technical report on trials and coupons and selection of the material and manufacturing processes	To + 7
D2	Technical Report 2	Technical report on optimised infusion process	To + 8
D3	Dry pre-forms availability		To + 12
D4	Flat stiffened skin composite panels	Two items available and inspected	To + 18

4. Topic value (€)

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 program.

5. Remarks

None

CFP topic number	Title		
JTI–CS-2010-5-ECO-01-015	Development of advanced preforms for LCM technologies	End date	*To +24*
		Start date	*To*

1. Topic Description

Composite preforms - Background

Liquid Composite Moulding (LCM) is a group of relatively new composite manufacturing technologies (LRI, RTM, RFI etc.) which were developed as an alternative to the currently used, traditional autoclave - prepreg technology for aerospace use. LCM involves two major steps. In the first stage dry fabric plies are cut and consolidated into a dry part preform. In the second stage, resin is injected into the preform. Compared with the autoclave - prepreg technology, LCM has labour cost as well as ecological benefits. Key advantages of LCM are listed below:

- Ability to produce large and integrated structures in "one shot"
- Use of cheaper raw materials with no shelf life limitations
- Ideal for serial production
- Reduction in energy consumption; oven is used instead of an autoclave
- Enables "net shape" structure design
- Reduction in waste
- Reduction in waste toxicity (carbon fabric replaces toxic prepreg material)
- Less exposure of workers to hazardous materials.

Currently, most of aircraft primary and secondary structures are produced by traditional prepreg - autoclave, multi - step, high energy processes. Development of typical integral structure preform design and manufacture will lead to production of one piece co - cured aircraft structures which will reduce aircraft weight, labour costs, process waste and energy resources.

Due to these advantages, there is a motivation for all aerospace composites industries to implement LCM technologies in their high quality aerospace structural applications.

During the first stage of the LCM process, fabrics are cut and consolidated into a rigid preform. Currently, fabric cutting is done either manually or by NC automatic cutting machines, which cut fabric flat plies according to the part model. Currently available commercial consolidation techniques are robotic stitching and bindering. The state of the art stitching technique, involves the use of an NC controlled robotic head, that inserts a needle with a thread that consolidates the plies firmly together. This technique is currently available for simple geometry applications e.g. control surface skins, simple fairings. More research and development is required for highly curved structures (e.g. double curvature), for typical skin sub structures (e.g. stringers) and for integral structures applications (e.g. stringers with skin). The stitching technique has clear ecological benefits (it requires minimum energy resources, no pollutants are emitted) but still need to be optimized in order to enable cost efficient and ecological serial preform production for integral structures applications. The bindering technique

involves the use of an epoxy binder that can be applied as an aerosol spray, dry powder spray and manually by brushing. This technique enables consolidation of very difficult shapes; however it has ecological disadvantages since it pollutes the environment as organic volatiles and epoxy powder particles are emitted and it requires an additional heating stage for preform consolidation with geometrically accurate shaping. This technique needs further technical and ecological improvements in order to enable efficient serial preform manufacture.
In order to increase implementation of LCM technologies, it is essential to improve currently used fabric cutting and preform consolidation techniques and to develop and verify new state of the art methods that shall enable ecologically sound, cost efficient serial preform manufacture for a wide range of structural applications.

CFP objectives

The objectives of this project are to further improve currently used technologies and to develop new technologies for fabric cutting & preform plies consolidation. All techniques must enable ecologically sound, cost efficient serial preform manufacture for several aerospace structural applications.

Scope of work

Development overview

In the first stage, a feasibility study of each consolidation technique shall be conducted. Each technique shall be evaluated for each of the required structural applications which are skin preform, T shape stringer, hat shape section stringer, integral stiffened structure, C - shape spar and I - shape spar. The study shall include the following stages:

1. Technique overview; review of current capabilities & limitation, previous experience on similar geometries and structures etc.
2. Coupon manufacture
3. Small scale demonstrator preform manufacture (up to 1/2 m long)
4. Technical evaluation including tolerances, net shape issues, process limitation, QA, serial production possibilities etc.
5. LRI testing will be performed
6. Review of cost and ecological aspects
7. Conclusions and recommendation for full scale preform demonstrators

In the second stage, full scale preform prototype demonstrators shall be produced. As a result of the feasibility study, each required structure will be manufactured by the selected consolidation technique (or techniques). Each manufactured preform shall be QA inspected according to preform requirements. The developed preforms shall be delivered for inspection. Resin infusion trials as a well as mechanical and physical testing shall be conducted. Preform improvements may be required according to preform test results.

Finally, a technical summary report shall be delivered describing all project activities, developed technologies, preforms manufacture, test results and recommendations for future serial production of preforms.

Preform structures:

The partner is required to develop preforms for the following structure dimensions and tolerances:

- **Skin preform**, this structure represents a section of a typical skin of an aircraft control surface. Preform dimensions are: length 2.5m, width 1 .5m, thickness variance 4 - 8 mm. The skin preform geometry shall be curved and shall include joggles and ply drop offs as defined. Local reinforcement of unidirectional plies is also required. The required tolerance for dimensions is ± 0.3 mm. General contour (and any other) tolerances is ± 0.3 mm.

  In addition, the partner is required to deliver final recommendations for larger skin preform manufacture, length - 8m long, width - 3 m, thickness 4 - 8 mm, (a demonstrator is not required for this application). This information shall be included in the project final report.
- **T - stringer preform**. This structure represents a section of a typical T - shape composite stringer. General dimensions are: width 50 mm; height 45 mm; thickness 3 mm. Radius shall be 3 mm. The required tolerance for width, height, radius & contour is ± 0.3 mm.
- **Hat section stringer preform**. This structure represents a section of a typical composite hat section stringer. General dimension are base width = 50 mm; height 30 mm. The top plies (hat plies) shall be layed upon Rohacel foam core. General tolerances ± 0.3 mm.
- **Integral stiffened skin preform with (i) T – stringers and with (ii) hat section stringers**. This preform shall integrate skin preforms developed in section 1 together with stringers that were developed in sections 2 and 3. Overall dimensions and tolerances are as defined in sections 1,2 & 3.

  In addition, the partner is required to deliver final recommendations for larger skin preform manufacture, length - 8m long, width - 3 m, thickness 4 - 8 mm, (a demonstrator is not required for this application). This information shall be included in the project final report.
- **C - shape spar preform**, representing a section of a typical torsion box spar. General dimensions are: length 2m, width 350 mm, height 40 mm, thickness 3-5 mm. Radius :3-5 mm. The required tolerance for width, height, radius as well as contour is ± 0.3 mm.
- **I - shape spar preform**. General dimensions are: length 2 m, width 150 mm, height 40 mm, thickness 3 - 5 mm, radius 3 - 5 mm. The required tolerance for width, height, radius as well as contour is ± 0.3 mm.

All above preform structure dimensions are based upon preliminary structure design, additional, small changes may be required according to final design specifications.

Three final satisfactory preforms, for each preform structure, shall be supplied.

These final preforms shall comply with all above preform requirements.

Preform materials:

The preform materials shall consist of advanced carbon non - crimped fabric (NCF) or an equivalent material. The fibre type shall be 12K, standard and intermediate modulus. NCF multi - axial (e.g. 0, 90, 45,-45) and unidirectional fabrics are required. Dry glass fabric type 120 (or 108) is required at the top and bottom preform surface.

Consolidation and cutting techniques:

The following techniques shall be developed by the partner:

- Automatic stitching (e.g. tufting, blind needle stitching or other innovative method)
- Thermoplastic veil application
- Ultrasonic welding
- Ecologically improved binder application
- Other innovative techniques as suggested by the partner

Each of the above techniques shall be designed for automated serial preform production. The final developed technique must cost efficient and must prove ecological benefits compared to currently used consolidation techniques.

Preform requirements:

The following list outlines general preform requirements:

- The preform shall enable an efficient resin infusion process; complete resin impregnation is required, no dry areas or porosities are allowed.
- Ply wrinkles are not permitted.
- Ply alignment ± 2 degrees.
- In the case of butt joint plies connection, ply gaps shall be no more than 1 mm.
- The preform must withstand all defined tolerances
- The cured preform laminate shall have the following properties:
  - Fibre volume fraction = 55% (minimal value)
  - Void fraction = 1.5 % (maximum value)

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

The partner shall be experienced with aerospace fabric preform manufacturing standards. Use of automated fabric preform machines e.g. ultrasonic welding , stitching robot is required for IAI defined applications .

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Supply small scale preforms	Partner to supply several small scale preform demonstrators for LRI test trials	To + 3
D2	Preform trials report	Technical report that outlines conclusions of small scale preform LRI trials, including feedback on preform quality and request for preform improvements	To + 4.5
D3	Feasibility study report	Feasibility report shall describe technical overview of preform development during feasibility study stages	To + 6
D4	Full scale skin preforms	Supply full scale skin preform demonstrators for LRI test trials	To + 8
D5	Skin preforms LRI test results - report	Technical report that outlines conclusions of skin preform LRI trials, including request for preform improvements	To + 9.5
D6	Full scale stringers preforms	Supply full scale T - stringer and hat section preform demonstrators for LRI test trials	To + 10
D7	Stringers preforms LRI test results - report	Technical report that outlines conclusions of stringers preforms LRI trials, including requests for preform improvements	To + 11.5
D8	Full scale integral preform demonstrator	Supply full integral shape preform with T stringers for LRI test trials	To + 12
D9	Integral preforms LRI test results - report	Technical report that outlines conclusions of integral preform LRI trials, including requests for preform improvements	To + 14.5
D10	Full scale integral preform demonstrator	Supply full integral shape preform with Hat section stringers for LRI test trials	To + 16
D11	Integral preforms LRI test results - report	Technical report that outlines conclusions of integral preform LRI trials, including requests for preform improvements	To + 18
D12	Full scale spars preform demonstrators	Supply full scale C - shape and I - shape preform demonstrators for LRI test trials	To + 20
D13	Spars preforms LRI test results - report	Technical report that outlines conclusions of spar preform LRI trials, including requests for preform improvements	To + 22
D14	Project report	Project report that outlines all project stages, and technical developments. The report shall include cost assessment and ecological parameters review for each preform structure	To + 23
D15	Conclusions	Project conclusions for serial full scale preform production	To + 24

4. Topic value (€)

The total value of this work package shall not exceed:

€ 250.000

(two hundred fifty thousand euro)

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

5. Remarks

If applicable

CfP topic number	Title		
JTI-CS-2010-5-ECO-01-016	Surface mapping to improve reliability of dry treatment on metallic and organic surfaces	**End date**	*To + 24*
		Start date	*To*

1. Topic Description

Dry treatments are environmentally friendly but require costly and time consumming checks.. The objective is to develop a sensor capable to monitor and to map the surface of aeronautical frame during their surface treatment process in order to detect bad treatment areas. Based on surface chemical analysis polluted areas are mapped and the sensor will deliver to a supervision system an information in order to reprocess thoses areas.

The system shall be inetgrated in an automate dedicated:

- to the treatment of composite prior painting in order to remove all released molding agent
- to the treatment of paint prior sealing in order to remove paint extreme surface rich in resin
- To the treatment of metallic substrates (Aluminium or titanium alloys)

Obviously, the sensor is a non contact sensor and the principle shall have no adverse effects on the properties of the surface or the substrate itself. Sensor shall work at atmospheric pressure and sampling shall be adjusted to the surface treatment speed.

The topic is focused on:

- The detection of main pollutants existing at the top surface of frame with respect to industrial processes
- The threshold of detection regarding paint and sealing adhesion.
- The pre implementation on an automate.

A side objective is to determine the thickness of material removed as well as the level of grafting.

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

The following skills and equipments are required:

- *A full controled equipment, sensor to monitor and map surfaces taking into account of several*
- *A system to analyse the chemical composition of the extreme surface*
- *A soft to exploit the mapping and to transfer info to the automate*

Real time control loop is not included in the topic, but info can be provided.

Process, control, detection shall be safe for the environment and workers and do not require important post cleaning.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Principle of the measure and accuracy	Report	To + 6
D2	Demonstrator/ Efficiency on aeronautical parts	Demonstrator	To + 12
D3	Improvement loops		To + 18
D4	Environmental analysis	Report	To + 18
D5	Implementation on automate	Demonstrator	To + 24

4. Topic value (€)

The total value of this work package shall not exceed:

250,000/00 €
[two hundred fifty thousand euro]

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

5. Remarks

If applicable

Topic description

CfP topic number	Title		
JTI-CS-2010-5-ECO-01-017	Production of yarns and fabric based on recycled carbon fibres	End date	*To + 24 Months*
		Start date	*To*

1. Topic Description

The rapid forecast growth in the carbon fibre (CF) composite market has focused attention on the need to find effective methods to re-use and recycle 'waste' CF materials. A high volume of CF waste is produced by a number of different sources in the composite manufacturing pipeline. These waste streams provide both discontinuous and continuous CF. Note that discontinuous CF may be derived from sources such as recovered woven fabric selvedge and multi-axial selvedge trim. Continuous waste CF is also available from CF tow remnants left over following manufacturing runs, although these materials are often in relatively short continuous lengths. CF waste is also becoming increasingly available via emerging technologies which recover fibre from uncured and cured parts through removal of the polymer matrix using different processing systems (solvent, thermal, fluidised bed and supercritical fluid/solvothermal).

Currently, the market for materials based on recycled CF is characterised by low performance and value, mainly consisting of milled fibres for injection applications and random mats based on short discontinuous fibres. The idea is to develop materials which exhibit significant performance enhancement and offer added value. The proposal is principally concerned with the reuse and recycling of waste CF from the available current waste sources to produce prepreg materials with discontinuous aligned long fibre as well as semi-continuous aligned fibre. Hence, it is essential to first develop a yarn or tape based on recycled carbon fibres which can be used in fabric structures such as unidirectional, non-crimp, 2D and 3D woven.

This proposal is to fill the gap in the production chain within Eco-Design Integrated Demonstrator Technology (ITD) project. A supplier of thermally recovered carbon fibres and several sources of waste CFs are already available. Additionally, the fabric impregnation with resin and the production of a demonstrator from the recycled materials will already be covered by the consortium. Potential applications include aircraft interiors and tooling.

This project would focus on thermoset resin–based prepregs. A high CF content is targeted within the yarn/tape. Additionally, any type of fabric structures (as listed above) is desired.

Thus, the applicants should be able to develop a yarn with high content of recycled discontinuous or semi-continuous aligned long carbon fibres which could be used for weaving. Another interested product would be tape-like material based on similar fibres, which could also be woven or used to manufacture non-crimp fabrics or mats. The main resin systems of interest are thermosets since they are more relevant than thermoplastics for applications such as tooling for which the resin should generally stand temperatures up to 180°C. High mechanical performance is not pursued in this work. The main yarn requirement is that its strength should be high enough to withstand weaving process. A specific fabric weight is not targeted, however a maximum weight of 800 g m^{-2} would be prefered.

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

- Yarn manufacture with high content of recycled discontinuous aligned long carbon fibres
- Yarn manufacture with high content of recycled continuous/semi-continuous aligned long carbon fibres
- Tape manufacture with high content of recycled discontinuous aligned long carbon fibres
- Unidirectional (UD) fabric manufacture
- 2D woven fabric manufacture
- Non-crimp fabric manufacture
- 3D woven fabric manufacture

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Supply of yarn from recycled discontinuous aligned long carbon fibres to be used with thermoset resins		To + 18 Months
D2	Supply of yarn from recycled continuous/semi-continuous aligned long carbon fibres to be used with thermoset resins		To + 18 Months
D3	Supply of tape from recycled discontinuous aligned long carbon fibres to be used with thermoset resins		To + 18 Months
D4	Supply of UD, non-crimp, 2D and 3D woven fabrics		To + 24 Months

4. Topic value (€)

The total value of this work package shall not exceed:

€ 250,000
[two hundred fifty thousand euro]

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

5. Remarks

If applicable

Clean Sky Joint Undertaking
JTI-CS-2010-5-ECO-01-018

Topic description

CfPtopic number	Title		
JTI-CS-2010-4-ECO-01-018	Environmental Data Models and Interface Development	End date	*T0 + 32 months*
		Start date	*T0*

1. Topic Description

The content of this call is directly following up work carried out within the Clean Sky Eco-Design following the outlines in [1].

Based on the current status of the Clean Sky EDA project consortium knowledge and the outcomes of the Clean Sky Eco-Design work outlined in [1], a Life Cycle Assessment (LCA) model shall be defined for a set of reference aircrafts. This includes identification of major components/parts, allocation of materials selection, and analysis of current processes for production, maintenance, and recycling/disposal. This analysis explicitly should cover the use of ILCD 1.1 (International Reference Life Cycle Data System) data format and data readily available.

The topics and activities in this call contain:

- A model that shall be transformable into a future reference aircraft, taking into account the progress in materials, processes, life time prediction, and recycling steps from the Clean Sky EDA project as well as from other sources which might be applicable.

- LCA modelling for the most relevant materials and processes for [illegible] friendly aircraft production, maintenance, and disposal

- identification of the most relevant processes in [illegible]

- set up a paramete[illegible] model for the ref[illegible]

- perform impact a[illegible] the reference and future aircraft

- provision of a s[illegible] of th[illegible] fleet level, and a benchmarking optio[illegible]

- delivery of a work[illegible] interface for the standard LCA tool (API: Application program[illegible] of the software interface with the EDA LCA tool

- the applicant sh[illegible] propose a method and project plan of cooperation with the CS EDA partners involved

- delivery of a milestone plan for a comprehensive documentation of the LCA models, of the current and future aircrafts, of the method and the contents as well as of the key findings has to be provided

- guarantee a cooperation with the CLEAN SKY Eco-Design project related to a call work element described in [1]

- establish an ongoing exchange, coordination and adaptation process between the applicant and the Topic Manager.

Topic suspended!

The LCA models and methods developed have to be applicable, flexible and customized for the aeronautics industry. Modeling has to be done in the standard LCA software tool GaBi (Ganzheitliche Bilanzierung) for verification.

Due to the complex structure of aircrafts, a function allowing to import Bills of Material into the software should be available, in order to reduce time required to model reference and future aircraft. A general methodological framework of Life Cycle Assessment in the aviation industry has to be developed.

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

The applicant has to show a multi-year track record of work in the field of LCA, and has to show that he already has worked in the aeronautics field in European publicly funded projects.

The work shall be carried out using the GaBi LCA tool to capitalize synergy effects from the CLEAN SKY Eco-Design funded project resting on the outlines [1] in order to reduce cost and workload and to ensure full compatibility of database, data sets and modells from the CLEAN SKY Eco-Design funded project related to the outlines [1].

Proven network in LCA community, materials suppliers sector and in professional knowledge of data acquisition in various sectors is required.

Access to the GaBi LCA software tool for source code modification is necessary to fully meet the specifications of this CfP in order to provide an adequate API for a maximum of automation. The LCA software tool must include functionality for a parametrized and flexible modeling of complex processes, especially in the aeronautic industry. Moreover, it must be guaranteed that the ILCD 1.1 support of the LCA software tool is available at project start.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	KOM MoM	Kickoff Meeting Minutes: shall provide a common basis of goal and scope of work	T0+4
D2.1	Progress Report 1 and presentation	progress report including methodology, assumptions, and detailed work plan	T0+10
D2.2	Progress Report 2	annual progress report	T0+16
D2.3	Progress Report 3	annual progress report	T0+28
D3	Reference a/c definition	basis for LCA work	T0+10
D4	Key findings Presentation		T0+28
D5	Comprehensive Documentation		T0+32
D6	ILCD Data base		T0+32

Topic suspended!

4. Topic value

The total value of this wo[illegible] ex[illegible]

€ [illegible]

hund[illegible] **nt.** [illegible]

Please note that VAT is [illegible]

5. Remarks

This CfP addresses the W[illegible] *.3 of the CS EDA project.*

The expected maximum to[illegible] *length is about 25 pages.*

6. References

[1] Related ECO Design Airframe work element

Title: LCA Databases Improvement

The content of this call was improvement of Life Cycle Assessment database, application and customisation for aerospace sector:

- Requirements and acquisition of LCA background data and datasets according to the specific needs of the aerospace sector e.g. from materials suppliers
- Harmonisation of Eco-Design activities with the ELCD system of the EC
- Life Cycle Assessment (LCA) of current and future system as benchmark (Life Cycle Inventory and Life Cycle Impact Assessment)
- raw material supply
- production and manufacturing
- identification of ecological weak-points
- sensitivity analyses on ecological impacts
- quantification of ecological improvements
- Modelling and calculation of selected parts for the current eco statement in the standard GaBi (Ganzheitliche Bilanzierung) LCA software for verification of data sets
- use of harmonised nomenclature of flows and accounting methods for flows like GaBi which will be clarified for the proposing partner

Topic description

Topic Nr.	Title		
JTI-CS-2010-5-ECO-02-006	Electrical Test Bench Power Centre	End Date	To+20 M
		Start Date	To

1. Acronyms

AC: Alternating Current
A/C: Aircraft
APU: Auxiliary Power Unit
ATA: Air Transportation Association (ATA chapter number 24 applies to “Electrical Power”).
BCV: Bi-directional Converter
BTC: Bus Tie Contactor
C/B: Circuit Breaker
CfP: Call for Proposal
DC: Direct Current
DPST: Double Pole, Single Throw
3PST: 3-Pole, Single Throw
EDS: Eco Design for Systems
eECS: Electrical Environment Control System
EMA: Electro-Mechanical Actuator
EPC: Electrical Power Center
EPDC: Electrical Power Distribution Center
ETB: Electrical Test Bench
F: Fuse
FBW: Fly By Wire
G: Generator
GA: Generic Architecture
GCU: Generator Control Unit
HVDC: High Voltage Direct Current
ICD: Interface Control Document.
ITD: Integrated Technology Demonstrator.
JTI: Joint Technology Initiative
L/G: Landing Gear
PBW: Power By Wire
POR: Point of Regulation
RCCB: Remote Control C/B
S/G: Starter/Generator
SSPC: Solid State Power Controller
TBC: To Be Confirmed
TBD: To Be Defined
TRU: Transformer Rectifier Unit
WIPS: Wing Ice Protection System

2. Applicable documents

The following applicable documents will be distributed to the Selected applicant:

[App. 1] CB-0021: ”Interface Control Document” ;

[App. 2] CB-0015: ”Electrical Architecture for the ETB”;

[App. 3] CB-0011: ”ETB Equipment List”, describing the type and the number of local benches to be connected to the central control command system;

3. Topic Description

Background:

In the frame of the Eco-Design ITD, an Electrical test bench (ETB) will be used by airframers to support verification activities, over different aircraft electrical architectures (Green Regional Aircraft, Green Business Jet and Green rotorcraft). In particular, this test bench will feature a HVDC network and will have the capability to integrate electrical starter-generators as well as different power-end consumers

Scope of work:

Subject of this call for proposal is the design, manufacturing, commissioning and validation of a complete Electrical Power Centre (EPC) for the test bench. The EPC is in charge of the electrical power distribution.

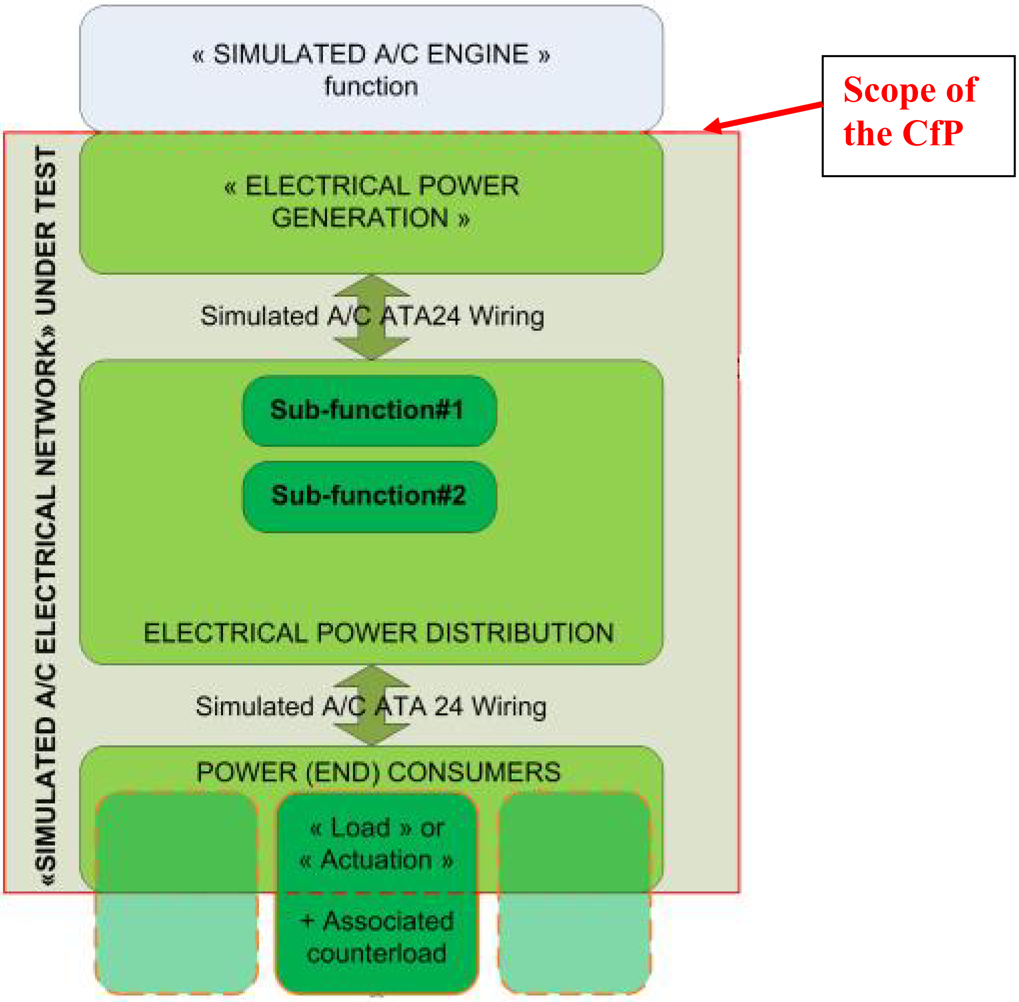


Fig.1: Electrical Test Bench : architecture dispatch by function

Description of the architecture

The proposed simulated Generic Architecture is composed of 5 HVDC and 3 LVDC bus bars, arranged in a 'loop' configuration. This architecture is the outcome of an airframers consensus, and aims at simulating a typical rotorcraft, business jet or regional aircraft EPDS. Therefore, this GA is still subjected to changes. For the two above reasons, the EPC should be modular and easily reconfigurable.

Each load is plugged on a bus bar, and its feeder shall be protected by the EPC. The layout of the current GA is shown in fig. 2.

The scope of the EPC is delineated by the blue dashed line in fig. 2. It includes all the bus bars, the wires (from the bus bar to the related protection device), the bus tie contactors, the measurement equipment and the wiring protection devices.

Moreover, the EPC interfaces (electrical and cooling connections, volume etc...) should comply with the specifications listed in an Interface Control Document (ICD).

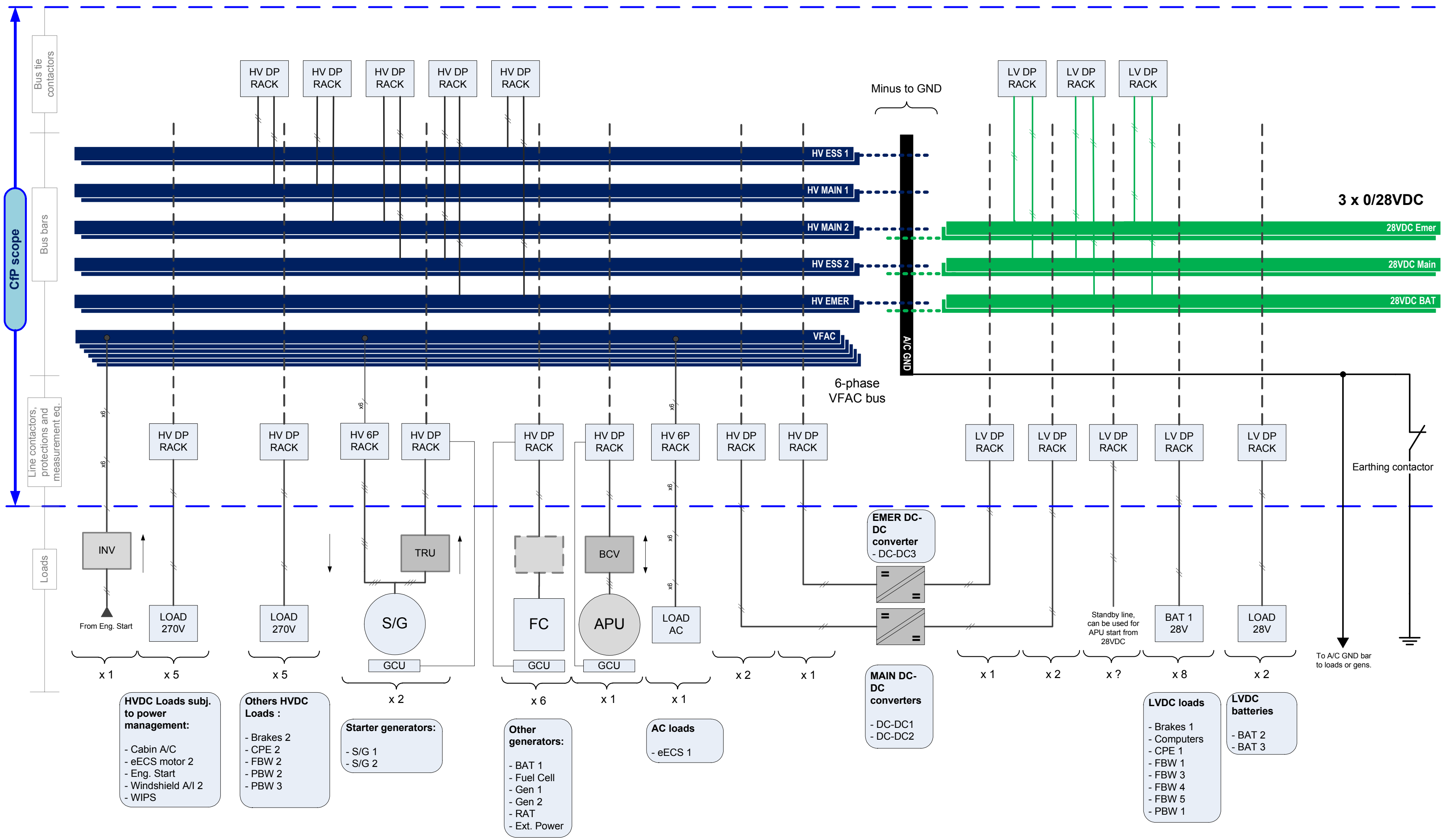


Fig. 2: Detail of the CFP Scope on the Generic Architecture

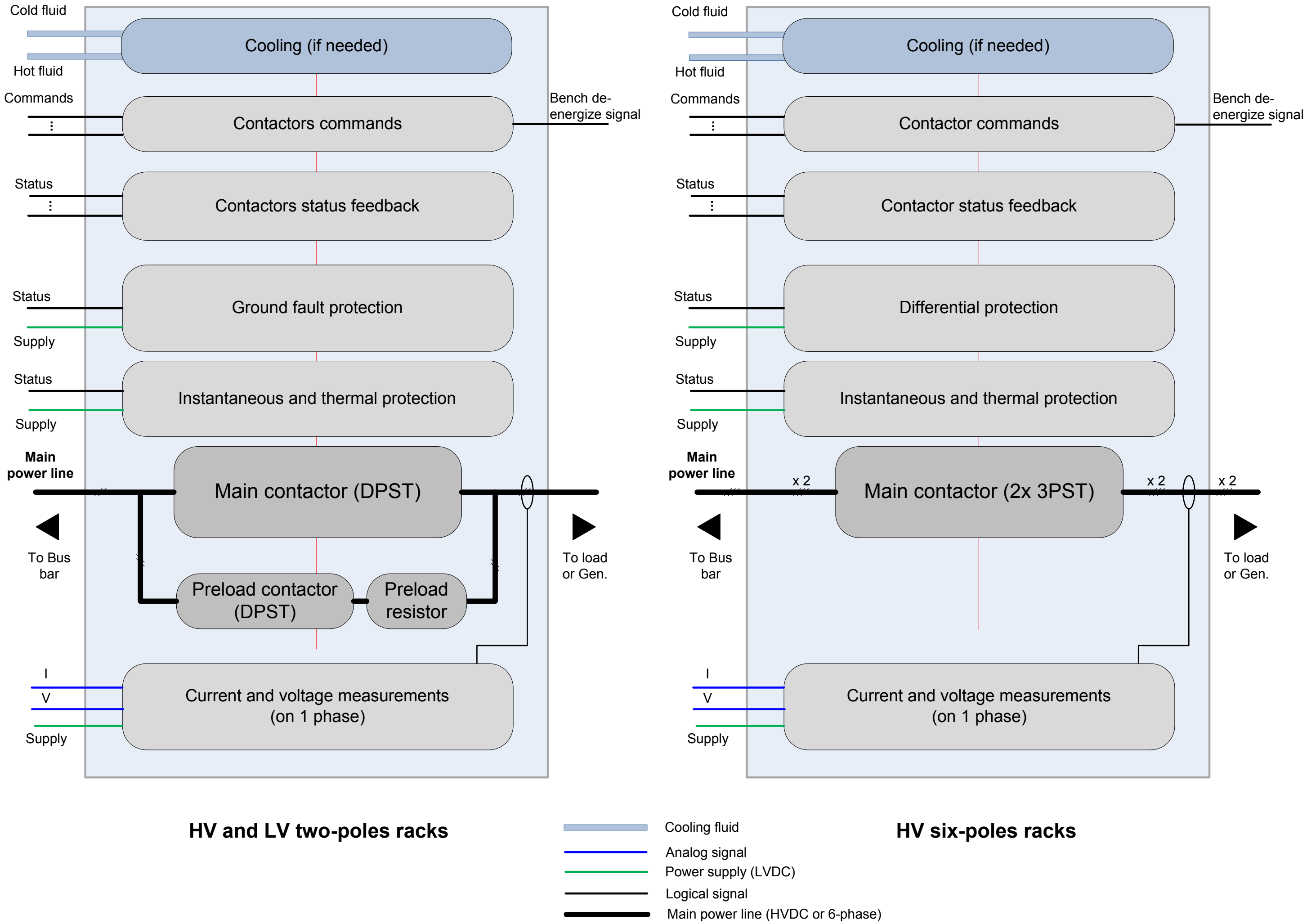


Fig. 3: "racks" functional description

Requirements:

Functional requirements:

- EPDS shall take power supply from electrical generation / conversion system and distribute it to other portions of the electrical system and loads;
- EPC shall be equipped with protection devices, part of the tested equipment, that shall selectively isolate the faulted area with minimum interruption of power, and shall enable non-faulted power systems and non-faulted equipments to operate in nominal conditions. Protection shall also work during abnormal conditions (failure configurations simulations);
- DC Electrical power: the EPC shall be designed to operate at 270VDC (0V/+270V or -135V/+135VDC) and 28VDC (1HVDC and 1 LVDC networks). The ability to go up to 540 HVDC (0V/+540VDC or -270V/+270VDC) is desirable;
- AC Electrical power: The EPC shall be designed to operate up to 230 VFAC, six-phase;
- EPC shall enable a complete manual reconfiguration of the simulated A/C architecture (loads and generators shall be able to connect to any bus bar);
- EPC shall include electrical connections for both electrical power and monitoring and control signals (EPC interface requirement: see the ICD);
- EPC shall enable easy replacement of commutation components to test different hardware (commutation component technologies / manufacturers, etc.);
- The EPC shall provide direct access for manual C/B reset (if any);
- The EPC critical components shall be representative of aircraft solutions, from a thermal and electrical point of view;
- The EPC shall handle:
  - Large voltage variations resulting from power supply and large loads transients;
  - Some loads whose power is in the order of a few kW that can reject power on the network.

Technical requirements:

- The EPC shall include (non exhaustive list):
  - 5 HVDC double-bars to distribute 270 VDC to loads, in a 'loop' configuration;
  - 3 LVDC double-bars to distribute 28VDC to loads, in a loop configuration;
  - 1 six-phase VFAC bus;
  - Electronic boards to transfer data to control/command test bench system;
  - Internal electrical connections;
  - Heat dissipation and cooling arrangement parts;
  - Preload resistors (amounts and values have to be determine by the partner, min. 14 elements.);
  - Part of the commutation elements (RCCBs or SSPCs, or other technologies);
  - Tension and current measuring devices, downstream to the commutation elements;

- The EPC shall integrate:
  - Circuit breakers;
  - Hall effect sensors for current and voltage measurements;
  - Some of the commutation elements (RCCBs or SSPCs) provided by an other manufacturer (to be specified).

- Each line shall have an independent protection to segregate single line failure;
- EPC equipment shall be air-forced or convection cooled but if SSPCs and other smart power switches require a more effective heat dissipation, a liquid cooling capability could be taken into account;
- EPC shall be equipped with separable feeders which can be dismounted without dismounting any EPC internal part;

- RCCBs shall ensure a complete galvanic insulation between both 270 VDC and LVDC networks;
- RCCBs shall be able to interrupt a current flow under high voltages conditions;
- SSPC: the current / power level which can be interrupted by the SSPC has to be evaluate by the partner according to the technologies available nowadays;
- Segregation between command and power circuits, power inputs and outputs circuits shall be assured for all commutation and commutation-and-protection devices.

Operational requirements:

- EPC shall continue to work for an acceptable period in case of lack of cooling features, to be sure we won't damage the EPC before we may stop safely the test performed;
- The MTBF of the EPDS shall be greater than 10 000 operating hours;
- Each EPC BUS bar shall withstand 1000 Amps of electrical current;
- EPC shall withstand a total electrical nominal power of 500kW;
- The system design shall avoid, as much as possible, scheduled maintenance. It shall enable rapid accomplishment of inspections, operational testing for malfunction detection and isolation, removal, installation and shop repair with a minimum of required skills and equipment. Supplier shall provide the methods and the actions to perform.

Safety requirements:

- EPC shall comply with European and French standards related to electrical power installations, and low voltage electrical installations;
- EPC shall open all the contactors, part of the tested equipment, as soon as the bench de-energize signal is triggered (emergency stop;
- Safety verification shall be performed whatever the EPC Configuration is.

Those two requirements are to be specified in the ICD;

- EPC will as far as possible comply with DO 254 for its hardware components.

Environmental requirements:

Those requirements are to be specified in the ICD.

The system will not include:

- The electrical power consumption through intelligent power management;
- The switching logics.

4. 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 system

The system should be innovative, either by the solution, or by technology, materials. As leads, you may explore fields like:

- Modular architecture, possibility to easily change the contactors (technology (SSPC, RCCB, etc.), rating, contactor manufacturer).
- Possibility to be used with different voltages (0/270Vdc ; +/-135Vdc ; 0/540Vdc ; +/-270Vdc ; AC voltage as well) for the distribution.
- Cooling system (natural convection, pulsed air cooled, liquid cooling, etc.).
- Use of safety means independent of the EPC tested equipment .

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 electrical power centre.

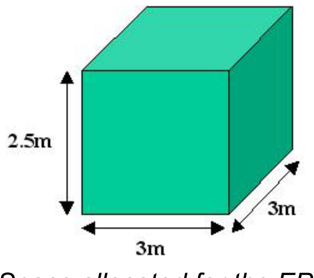
Criteria to meet:

The system will be as compact as possible but may be handy for maintenance and manual operations: the electrical power centre should be contained in a specific allocated space: 3m x 3m x 2.50m (l x L x h) as a maximum. the 9m² is a total working allocated surface that shall include personnel access to perform the required operations on the equipment or its ancillaries. Those operations are, but may not be limited to:

- Assembly,
- Rigging;
- Maintenance operations.

Operations on a dedicated area/equipment shall not impact another equipment-dedicated area..

The compactness of the proposed solutions will be a selection criteria for the CfP.



Space allocated for the EPC

- The system will require reduced maintenance time, have a low cost of operation and a high level of safety and robustness

The scope of the CfP is design, manufacture, integration and validation of the system.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	PDR	Preliminary Design Review	T0 + 3 months
D2	CDR	Critical Design Review	T0 + 6 months
D3	Manufacturing	Delivery of the complete systems	T0 + 12 months
D4	Commissioning	Commissioning of the complete systems	T0 + 16 months
D5	Support	Further to the commissioning on site, the CfP Supplier shall support the rig operations to correct potential faults during this probation period.	T0 + 20 months

6. Topic value (€)

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

€ 700.000,--
[Seven hundred thousand euro]

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

7. Remarks

Please refer to the separate document provided as part of the Call Text

Clean Sky - Green Regional Aircraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	**2**	**620.000**	**465.000**
JTI-CS-GRA-01	*Area-01 - Low weight configurations*		**170.000**	
JTI-CS-2010-5-GRA-01-034	Design, manufacturing and impact test on selected panels with advanced composite material		170.000	
JTI-CS-GRA-02	*Area-02 - Low noise configurations*		**450.000**	
JTI-CS-2010-5-GRA-02-014	Wing loads control/alleviation system design for advanced regional Turbo-Fan A/C configuration		450.000	
JTI-CS-GRA-03	*Area-03 - All electric aircraft*			
JTI-CS-GRA-04	*Area-04 - Mission and trajectory Management*			
JTI-CS-GRA-05	*Area-05 - New configurations*			

Topic Description

CfP topic number	Title		
JTI-CS-2010-5-GRA-01-034	"Design, manufacturing and impact test on selected panels with advanced composite material"	End date	T_0 (**)
		Start date	T_0 + 8 months

Note (**): T_0 is the effective date of contract

1. Topic Description

Acronyms

CFRP	Carbon Fibres Reinforced Plastics
CNT	Carbon Nanotubes
PN	Polymer Nanocomposite

1.1 – Scope of work

The contractor shall manufacture n.1 CFRP composite panel using as a matrix a PN resin, produced under materials specification provided by the prime, and N.1 carbon fiber reinforced composite panel using the same, unfilled, neat resin (for comparison purposes). The two panels shall be produced either by liquid infusion processes or by pre-preg technology, under materials and geometric specifications provided by the prime.

The contractor shall also performs an impact test, in accordance to test standards provided by the prime, on the two panels.

1.2 – Reference documents

ASTM Standards for testing of CFRP

1.3 – Introduction

1.3.1 - Background

Polymer nanocomposites represent a fairly new class of polymeric composites with promising mechanical, thermal, optical and physic-chemical properties, obtained with a rather low filler loading. The filler employed in the production of nanocomposite resins are typically clays (layered silicates), nanospheres (silica), nanoscopic metal or metal oxides, and carbon nanotubes and fullerenes. Generally, the nanometric fillers are chemically treated with organic modifications in order to improve their affinity with the polymer chains, thus helping the nanoscale dispersion process.

One of the objectives of technological activities within the GRA-ITD is the demonstration of the nanocomposite technology for structural and functional improvements in structural CFRP panels. The use of a nanofilled thermoset resin in the manufacturing of a structural CFRP panel may potentially lead to structural properties enhancements (such as impact resistance) as well as to the occurrence of all new functional properties (electrical conductivity, flame retardancy) on account of the spcific nanocharge chosen for the nanofilled resin production.

The subject of the present Call for Proposal aims at bridging the gap between laboratory scale nanofilled resins production and actual composite panel manufacting, with a demonstration of feasibility of a production process of CFRP panels using PN resins.

1.3.2 – Interfaces to ITD

The activities of the present Call for Proposal are part of the WP 1.3 of the GRA ITD, dedicated to the evaluation of new core technologies. More specifically, they are inserted in a line of research started within the WP 1.3.5, that was aimed at evaluating properties enhancements in nanofilled resins for aeronautic applications.

A kick-off meeting will be held at the beginning of the activity in order to supply the materials requirements for nanocomposite resin production (resin type and nanofiller type, chosen between CNT or inorganic nanofillers) and the CFRP panels requirements for the production of the stiffened panels (stacking sequence, exact geometry).

1.4 - Activity Description

The contractor shall produce a nanofilled thermoset resin using materials specifications (type of resin and type of nanofillers) provided by the prime. The nanofilled resin shall be employed in the manufacturing of N.1 stiffened composite panel of approximate lateral dimensions of 2meters x 2 meters, using carbon fiber fabrics specified by the prime. The same resin used in the production of the nanocomposite matrix will be employed in the production of a second panel, having the same geometry, stacking sequence and carbon fibers type as the nanocomposite one, for comparison purposes.

The contractor is responsible for all materials procurement.

The panels will be produced in accordance to precise geometrical specifications provided by the prime.

Finally, the contractor shall also perform an impact test, in accordance to test standards provided by the prime, on the two panels.

The activities that shall be performed by the contractor are divided into the following three work-packages:

WP 1000 – Nanofilled resin production

Within this workpackage, the contractor shall produce an amount of nanofilled resin (using materials specifications provided by the prime) necessary for the production of a composite panel of approximate lateral dimensions of 2meters x 2 meters (exact geometry and stacking sequence provided by the prime)

WP 2000 – Reference panel and nanocomposite panel production

Within this workpackage, the contractor shall produce 2 carbon fibers reinforced composite panels using respectively the nanofilled resin produced in WP1000 and the base neat resin. The composite panels specifications (geometry and stacking sequence). will be provided by the prime.

The contractor may use for the production either liquid infusion tecniques or pre-preg technology.

WP 3000 – Impact test

Within this workpackage, the contractor shall perform an impact test on the two panels following test standards provided by the prime.

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

The contractor shall have a proven experience in the field of polymer composites and nanocomposites processing, and have full access to polymer composites processing plants and facilities.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
Del.1	Nanofilled resin production report	Within this technical report, full details on the production of the nanocomposite resin to be used as a matrix in the realization of the composite panel shall be provided (dispersion method, handling procedures, ecc).	T_0 + *5*
Del. 2	Composite panels manufacturing report	Within this technical report, full details on the production of the composite panels shall be provided (type of process, process parameters, critical aspects, quality concerns, ecc)	T_0 + *7*
Del. 3	Composite panels	2 composite panels, one with a nanofilled matrix, one with the neat resin as a matrix	T_0 + *8*
Del. 4	Impact test report	Within this technical report, the results of the impact tests performed on the two panels shall be reported and critically discussed.	T_0 + *8*

4. Topic value (K€)

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

€ 170.000,--
[One hundred seventy thousand euro]

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

5. Remarks

The activity will be monitored by mean of bi-monthly meetings that will be held alternatively at the prime's or the contractor's premises. Within each of these meetings, a progress report shall be delivered by the contractor.

Clean Sky Joint Undertaking
JTI-CS-2010-5-GRA-02-014

Topic sheet

CfP topic number	Title		
JTI-CS-2010-5-GRA-02-014	Wing loads control/alleviation system design for advanced regional Turbo-Fan A/C configuration	**Start date**	T_0 (**)
		End date	T_0 + 10 months

Note (**): T_0 is the effective date of contract

1. Topic Description

Short description

Loads control and alleviation devices aerodynamic design, aero-elastic modelling/preliminary structural lay-out, relevant kinematics and actuation preliminary solution applicable to 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 to be 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.

In 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 flight phase to reduce the annoyance perceived by the resident population in the airport's neighbourhoods;

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 to 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 optimize the wing structural design for A/C weight savings.

1.1.2 Interfaces to ITD

The subject-work of the present CfP is concerned with a multi-disciplinary design (aerodynamics, loads, aero-elasticity, structures, systems), along with the optimisation of load control and alleviation wing devices starting from the wing baseline configuration 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, MATLAB). Note that this requirement is not strictly related to the CAE tools to be used during the analysis.

1.2 Scope of the work

The present work aim is to reach the LC&A wing devices conceptual design for future applications to a green Turbo-Fan Regional A/C configuration. This is part of the technology development phase, planned within the LNC project.

Topics and expected outcomes of the activity inherent to the present Call for Proposals are dealing with: i) CFD based, aerodynamic design of relevant LC&A wing innovative devices, ii) preliminary lay-out definition of respective structure and actuation system, iii) parametric analysis of devices performance and settings for a transonic wing configuration (cruise Mach = 0.78) with engine-nacelle, under wing installation for a future Turbo-Fan Regional A/C configuration;

1.3 Type of work

LC&A devices aerodynamic (CFD) analysis & design, devices structural (FEM) modelling and preliminary design; structural/aero-mechanics analysis (aerodynamic and loads), devices actuation preliminary lay-out definition; device performances parametric analysis; static and dynamic aero-elastic analyses (including commands inversion speed verification and wing flexibility aeroelastic deformations impacts on device efficiency); devices preliminary kinematics modelling and dynamic simulations.

1.4 Abbreviations & Definitions

A/C	Aircraft
ACARE	Advisory Council for Aerospace in Europe
AoA	Angle of attack
AR	Aspect Ratio
Bm	Bending moment
CAD	Computer Aid Design
CFD	Computational Fluid Dynamics
C_D	Drag coefficient
C_L	Lift coefficient
C_m	Pitching moment coefficient
D	Drag
EHA	Electro Hydraulic Actuator
EHA	Electro Mechanical Actuator
FEM	Finite Element Model
HLD	High-Lift Devices
L	Lift
LA	Load alleviation
LC	Loads control
LC&A	Loads Control and Alleviation
LE	Leading Edge
LNC	Low-Noise Configuration
Mach	Mach number
MDO	Multi-Disciplinary Optimisation
Piezo	Piezo electric actuator
Sh	Shear
SMA	Smart Metallic Alloys
T	Tension
TE	Trailing Edge
TR	Taper Ratio
TRL	Technology Readiness Level
2D	Two-Dimensional
3D	Three-Dimensional

Note:
Aerodynamic coefficients refer to the fuselage/wing/pylon/nacelle geometry (cruise configuration), including tipical flight controls, LC&A devices contributions plus HLD (high-lift devices).

1.5 Description of the 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 – LC&A wing devices aerodynamic sizing

This phase of the work will be dealing with the devices configurations aerodynamic preliminary sizing (size, wing position, setting, etc.), based on LC&A concepts aerodynamic performance prediction by numerical simulations.

In particular, the following devices technologies/solutions are envisaged to be addressed:

- Movable Winglet: device equipped with trailing edge devices and/or able to cant around

longitudinal A/C axis, adapting device shape to flight,
conditions minimising aerodynamic wing loading and induced drag.

- Wing Tip devices: devices applied to the wing tip, in order to minimize gust dynamic wing loading.

Relevant concepts or solutions usage can be combined each other and with classical wing control surfaces in the aim to maximize concept efficacy (wing loads and performances) and/or to simplify wing both control surfaces and HLD baseline configuration:

- Ailerons: used symmetrically in order to alleviate manoeuvre loads and gust dynamic wing loading,
- HLD devices: used in non conventional way at high speed in order to improve wing performance not only in cruise but also in climb, descent flight regimes and at different target C_L.

Reference fuselage, wing and pylon/nacelle baseline configuration geometry will be provided as input. The fuselage and wing geometry shall not be modified.. Aileron baseline configuration shall not be provided as an input and it shall be defined during work.

Reference for any comparison work is always the above reference wing baseline configuration.

Inputs:

a) 3D geometry (CAD model) of fuselage and wing/pylon/nacelle reference configuration (including baseline HLD);

Outputs:

a) Wing with devices configurations parametric models: i) CAD model , ii) CFD mesh (NASTRAN bulk data format) (°);

b) Prediction of concepts aerodynamic wing loads and drag performances, as from CFD analyses results: i) wing aero loads (Sh, Bm, T) and aero coefficients versus device settings; ii) wing and wing body aerodynamic coefficients (C_L, C_D, C_m); iii) wing pressure and Mach number distributions; iv) wing, aileron and LC&A devices aerodynamic mesh (NASTRAN bulk data format)(°); v) A/C stability and control derivatives for baseline and devices presence and settings.

(°) CFD analysis shall be performed using high order methods (RANS-URANS). Nastran bulk data format is only used for an expedite mesh data or results exchanges.

1.5.2 Task 2 – Devices concepts feasibility and development

Starting from the device aerodynamic design (Task 1), the second phase of the activity will be an LC&A devices concepts development, considering feasibility TRL improvement trend and actuations/structural architectures, materials characterisation sized upon Regional A/C configuration. In this activity, par each of Task 1 developed concepts, the following activities will be performed:

- sub-structure, skins, preliminary lay out, material requirements, preliminary sizing and FEM modelling;

- actuation concept preliminary lay out and architecture definition, in particular with reference to an advanced structural integrated actuation (SMA, Piezo) and/or alternative concepts based on EMA or EHA actuators;

Par each of Task 1 concepts, a TRL evaluation shall be performed considering the following issues: i) needed materials, ii) structural lay out, iii) device assembly, iv) actuation, v) safety aspects.

Inputs:

a) FEM (NASTRAN model) of baseline wing box preliminary lay-out;
b) Additional structural data of the baseline wing box model: i) structural weight of the 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;
c) Prediction of concepts aerodynamic wing and device loads from CFD analyses results (from task 1): i) wing aero loads (Sh, Bm, T); ii) device settings and performances parametric data.

Outputs:

a) Par each Task 1 developed LC&A concepts: sub-structure, skins, materials of the preliminary structural lay out model (CAD) and of the preliminary sized structural FEM (Nastran bulk data format);
b) Par each of LC&A concepts developed in Task 1: i) Actuation preliminary requirements, ii) actuation preliminary device and control model (Matlab-Simulink format), including assumptions about needed actuation and sensors adopted configuration, in order to simulate device performances and failure states;
c) aero-structural TRL assessment par each of LC&A concepts developed in Task 1.

1.5.3 Task 3 – Devices Parametric Analysis

Based on Task 1 and 2 modelling and results, a trade-off study is requested to evaluate LC characteristics (device size, setting, position) changes wrt baseline wing and A/C performance in order to fix the possible and feasible device configuration to be adopted.

First step of parametric investigation will be performed for Task 1 sized concepts effectiveness, upon wing loads and / or A/C performances. The aerodynamic sizing performed in Task 1 shall be checked by mean of a trade off study considering performance sensitivity to small variations of device sizing and position, in order to define correctly a following possible optimization problem (not included in this proposal).

For this analysis A/C shall be trimmed using stability and control baseline data, combined with LC&A device contributions. Wing loads and/or A/C performances shall be calculated in each trimmed point, in order to evaluate the devices performances versus the trimmed A/C baseline polar. This evaluation shall consider also the wing flexibility.

Second step of parametric studies shall consist in a sensitivity study of the concepts performances versus small variations of wing configuration like A/R, geometrical twist, structural flexibility variations, etc. The selection of parameters to consider shall be selected taking into account the device characteristics.

Inputs:

a) Devices configurations aerodynamic scaled parametric models (Task 1);
b) Parametric prediction of concepts aerodynamic performances (Task 1);
c) Device sub-structure, skins, actuation lay out and architecture rough parametric modelling (CAD and CAE models) - (Task 2);
d) Device actuation and control model (Task 2).

Outputs:

a) parametric concepts LC performance parametric model wrt reference wing;
b) parametric LC performance evaluation results: C_L over C_D and load alleviation reached levels with respect to baseline wing configuration (trimmed results) and relevant device settings and device sizing variations;
c) parametric concepts LC performance model wrt devices reference configuration;

d) parametric LC performance evaluation results: C_L over C_D and load alleviation reached levels with respect to reference device configurations, settings and wing sizing variations (trimmed results) for the reference devices configurations.

1.6 Requirements

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

1.7 Milestones

M1 (T_0 + 5 months):

a) Release of Wing LC&A devices aerodynamic configuration CAD model (deliv. D1);

b) Release of Wing LC&A devices aerodynamic configuration CFD model geometry (deliv. D2);

c) Release of prediction results for devices concepts aerodynamic wing loads and wing performances studies (deliv. D3).

M2 (T_0 + 7 months):

a) Release of lay out model for LC&A concepts: materials, preliminary structural lay out model (CAD), preliminary sized structural FEM (deliv. D4);

b) Release of: i) actuation preliminary requirements ; ii) aero-structural TRL assessment (deliv. D5).

M3 (T_0 + 10 months)

a) Release of parametric concepts LC&A performance parametric models with respect to reference wing and wrt devices reference configuration (deliv. D6);

b) Release of parametric LC&A performance evaluation results (deliv. D7);

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

Deliverable	Title	Description (if applicable)	Due date
D1	Wing LC&A devices aerodynamic configuration CAD model for a Green Regional Turbo-Fan A/C configuration		T_0 + 5 months
D2	Wing LC&A devices aerodynamic configuration CFD model geometry for a Green Regional Turbo-Fan A/C configuration		T_0 + 5 months
D3	Report of prediction of concepts aerodynamic wing loads and drag performances from CFD analyses results for a Green Regional Turbo-Fan A/C configuration	Report describing results from aerodynamic preliminary LC&A device sizing (see Task 1)	T_0 + 5 months
D4	Preliminary lay out model for LC&A concepts for a Green Regional Turbo-Fan A/C configuration	CAD and sized structural FEM models including preliminary definition of materials (see Task 2)	T_0 + 7 months
D5	Report of LC&A concepts actuation preliminary requirements and aero-structural TRL assessment for a Green Regional Turbo-Fan A/C configuration	Report describing results of aero-structural and actuation evaluations of LC&A concepts (see Task 2)	T_0 + 7 months
D6	Parametric concepts LC&A performance parametric models with respect to reference wing for a Green Regional Turbo-Fan A/C configuration	(see Task 3)	T_0 + 10 months
D7	Report of parametric LC&A concept performance evaluation results with respect to baseline wing configuration of a Green Regional Turbo-Fan A/C configuration	Report describing trade off study considering LC&A system performance sensitivity to small variations of devices sizing and small variations of wing (see Task 3)	T_0 + 10 months

4. Topic value (K€)

The total value of biddings for 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* program.

5. Remarks

N/A

Clean Sky Joint Undertaking
Call SP1-JTI-CS-2010-05
Green Rotorcraft

Clean Sky - Green Rotorcraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-GRC	**Clean Sky - Green Rotorcraft**	**7**	**11.580.000**	**8.685.000**
JTI-CS-GRC-01	*Area-01 - Innovative Rotor Blades*			
JTI-CS-GRC-02	*Area-02 - Reduced Drag of rotorcraft*			
JTI-CS-GRC-03	*Area-03 - Integration of innovative electrical systems*		**930.000**	
JTI-CS-2010-5-GRC-03-004	Innovative management of energy recovery for reduction of electrical power consumption on fuel consumption		500.000	
JTI-CS-2010-5-GRC-03-005	Adaptation kit design & manufacturing: APU Driving System		430.000	
JTI-CS-GRC-04	*Area-04 - Installation of diesel engines on light helicopters*		**9.950.000**	
JTI-CS-2010-5-GRC-04-003	Optimised Diesel engine design matching a new light helicopter architecture		650.000	
JTI-CS-2010-5-GRC-04-004	Diesel Power-pack Integration on a light helicopter demonstrator		9.300.000	
JTI-CS-GRC-05	*Area-05 - Environmentally friendly flight paths*		**300.000**	
JTI-CS-2010-5-GRC-05-004	Tuning of simplified rotorcraft noise models. Preliminary acoustic measurement test campaign		300.000	
JTI-CS-GRC-06	*Area-06 - Eco Design for Rotorcraft*		**400.000**	
JTI-CS-2010-5-GRC-06-001	Manufacturing of a Thermoplastic Composite Feasibility Article for a Helicopter Door		200.000	
JTI-CS-2010-5-GRC-06-002	Manufacturing of thermoplastic structural demonstrators		200.000	

Topic Description

CfP topic number	Title		
JTI-CS-2010-5-GRC-03-004	Innovative management of energy recovery for reduction of electrical power consumption on fuel consumption	End date	To +29 months
		Start date	To

1. Topic Description

1. Background:

The Green Rotorcraft research consortium of Clean Sky invites proposals for the generic study and development of innovative solutions for continuous, in flight energy loss recovery power management in rotary wing aircraft.

The overall aim of this call is to provide the ability to utilise in flight, the recovered electrical energy through a high dynamic range of bi-directional power flow (including rapid storage) connected (directly or not : to be selected during the development by the Topic Manager)) onto the aircraft systems common power distribution bus network and to minimize main power sources mechanical power take off (reduction of fuel consumption). These recovered energies are based on two types : static energy recovery (thermoelectric module) and dynamic energy recovery (electrical generator).

The static and dynamic energy recovery involves a variation of power function of the delta temperature and its delivered current shall be controlled and managed.

* Static recovery: Thermoelectric modules require impedance matching to be done to guarantee maximum available power transmission to the load (DC bus, storage systems…). Taking into account that environmental conditions will constantly vary, impedance matching will be able to keep the supplied power to its highest value continuously. Using a converter is one of the simplest ways of solving this difficulty. In fact, the variation of the duty cycle of this converter plays the role of a dynamic impedance matching. This converter shall be adapted to the characteristics of the thermoelectric modules (maximum output power, current/voltage levels…) and also to those of the components connected to the output of the converter. The control of the duty cycle can be made using different control methods (i.e. MPPT Maximum Power Point Tracking). The recovered power could be used to directly feed loads trough the bus and to be accumulated in storage elements.

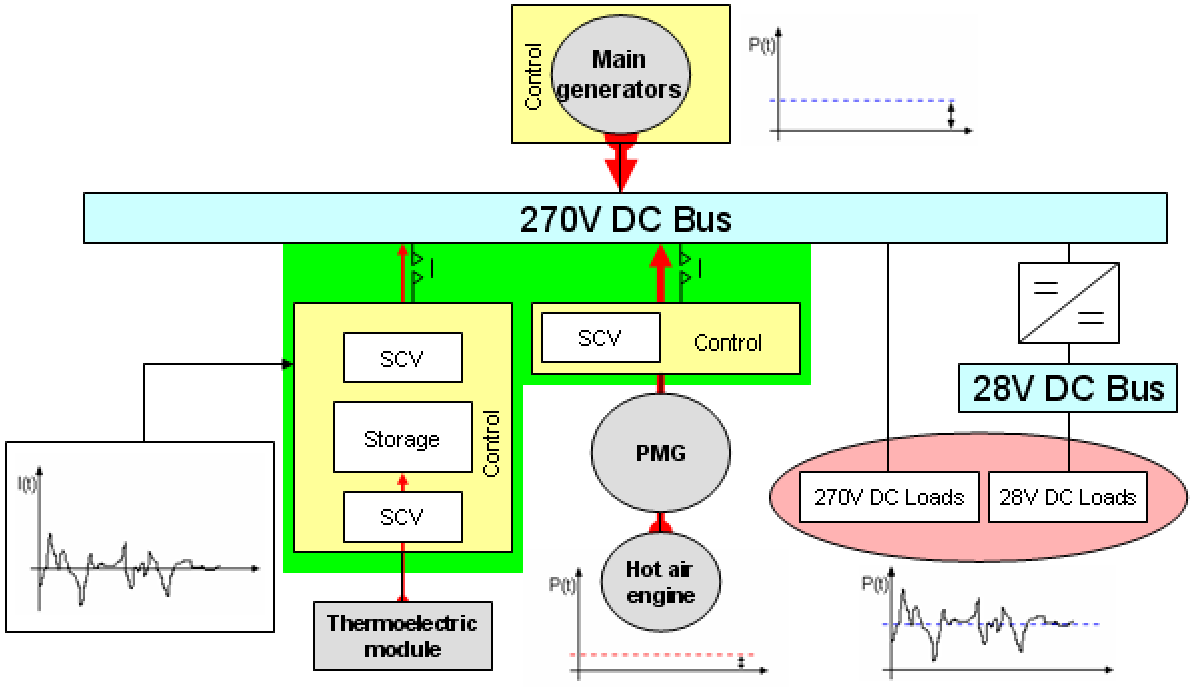
* Dynamic recovery: The interest of this kind of energy recovery system is to constantly supply a part of the energy provided by main sources due to the amount of power that could be recovered (about 20 to 30 times the amount of power recovered by the static way). Because of the variation of temperature, the generators shaft speed shall vary and so the load characteristic (Vout [Volts] vs N [rpm]) of electrical machine. On the contrary, the HVDC bus voltage will be kept constant thanks to the voltage control loop of the main power sources. The coupling of the generator to the bus could be made by means of a static converter. This converter shall guarantee the MPPT function to recover the maximum available power. The converter shall be adapted to the generator and the HVDC bus qualities (power, current/voltage…).

To assist understanding of the key performance parameters, an indicative target maximum power for this program will be of the order of 1 KW for Static recovery to 30 KW for dynamic recovery . These values are provided as target performance challenges to asses the viability of the technology in this application. Proposals may not be considered to meet these exact criteria for the demonstration, but exhibit a scalable performance capability by modular approaches or achieve a nominal performance of the same order.

Key advantages sought are:

- Storage and direct use of recovered waste energy in common electrical form to improve overall vehicle energy demand efficiency,
- Use of recovered energy prior to energy produced by main sources to mitigate designed for peak and permanent generation capacity demand ,
- Improved integrity and failure management re-configuration options in providing diversity of power sources in all electric aircraft.
- Improved equipment efficiency and cooling (air – liquid,…) function of consumed power (increasing of reliability).
- Common module distributed remote computerised power control and conversion interfaces on common busses.

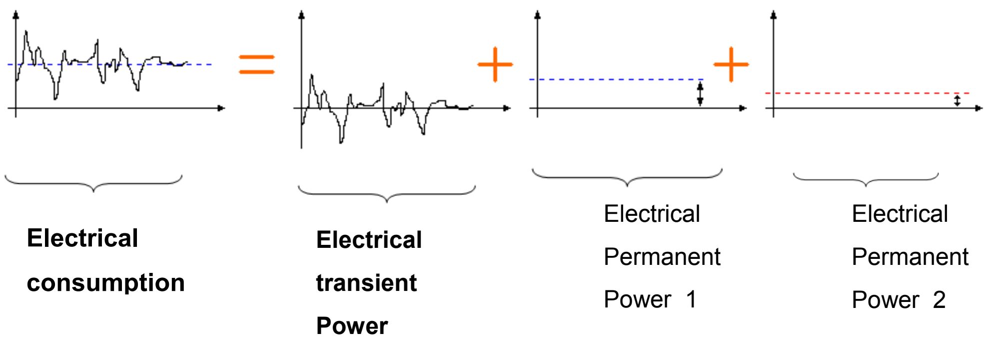
General overview of this project :



Parts of this project are highlighted in green on the figure .

Objective :

- The total equipment Electrical consumption is composed by :
    - * transient => to be provided by the thermoelectric module (energy recovery) ,
    - *Permanent 1 => to be provided by the main generator (mechanical power take off),
    - * Permanent 2 => to be provided by the dynamic thermal generator (energy recovery) .



The program of work shall include analysis, design and development of a technology demonstration system to be integrated into a ground based full aircraft power system demonstrator test program (EDS electrical rig) based at least on a TRL 5 , objective being TRL 6 .

Critical performance and design criteria include energy conversion efficiency, power management efficiency (ratio between the maximum recoverable energy and the recovered energy supplied to the network), power density / unit mass (objective around 3 KW / Kg including filtering and cooling) and volume.

These parameters must be sufficient for the recovery system to be potentially self financing by making a net saving in fuel consumption and through life cost for its introduction. Low maintenance demand will also be a key design migration aim.

Technologies will need to be intrinsically safe and minimise the use of hazardous materials or emission of 'greenhouse' gasses such as CO_2.

Protections for human security (270 Vdc) shall be part of the analysis – design and included in the demonstrator delivery .

The leading specific objectives to be demonstrated will include:

1) High capacity rapid charge & discharge capacitor storage technology,

2) Modular standardised bidirectional (digital or analogical) control power interface modules to ensure supply of loads while consuming maximum recovered energy and to store recovered energy into super capacitor or battery.

It is important that a modular and scalable approach is adopted.

During the negotiation phase , technical specification and Statement of Work will be performed to be part of the contract .

2. Scope of work:

The study will comprise:

- Work package 1 - Identification of the converter technology and topology potential matched to airborne system application

Performance characteristics including limitation factors, environment/installation, and issues in relation to airborne application (Power available function of thermal environment) and to power management efficiency.

- Work package 2 - Identification of potential solution options – selection of the optimal solution

* Part I : These will be developed sufficiently to identify potential physical implementations and to simulate energy management & their electrical behaviour using tools compatible with SABER .

For each solution, modelling aircraft system waveform integration and parametric assessment will be developed to include:

* an energy flow behavioural model including Helicopter network integration,
* a parametric mass / volume / cost effectiveness model

* Part II - Selection by the Topic Manager of the optimal solution to perform a detailed analysis and to manufacture the demonstrator

- Work package 3 - Optimal solution manufacturing for demonstrator implementation taking into account network stability (regulations dynamic ;consequence problems; standard MIL STD 704 F and EN 2282)

* Part I -Detailed study of the selected solution including behavioural simulation (modelling with SABER simulation tool) ,
* Part II - Manufacture of a physical and functional demonstrator
* Part III - Integration tests of capability potential and model verification in a ground/laboratory in the Applicant facilities (including test plan , test procedures, …)
* Part IV – Update of Saber models following test results correlation with simulations

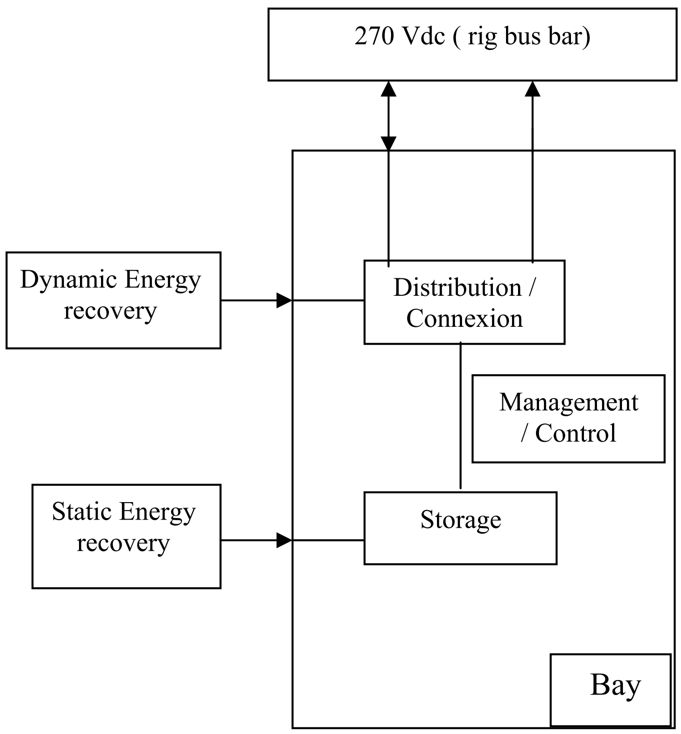
The Applicant shall support integration tests of the demonstrator on an Electrical network (tools , integration, rig & demonstrator adaptations ,…).

- Work package 4 - JTI GRC Demonstration Program support (on EDS rig)

* Part I – Support of demonstrator integration tests on EDS rig (tools , integration, rig & demonstrator adaptations ,…).
* Part II - Delivery of the demonstrator to EDS electrical rig
* Part III - Update of Saber models following the EDS electrical rig test results correlation with simulations
* Part IV - Extrapolations on aircraft integration function of H/C power range

The Applicant shall support integration tests of the mock up on EDS rig (tests are planned in 2013 & 2014) . The electrical and mechanical interfaces for EDS rig integration will be provided during development phase by the Topic Manager .

Detail of the realisation : One bay (Electrical Storage and Power Management Module) will be developed :



Note : The Applicant will support integration tests of the demonstrator on an Electrical network.

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

The applicant should be able to cover the complete process chain from the study of various solutions to the manufacturing of the selected one.

The applicant should have the industrial capacity to exploit the demonstration results – i.e. to further develop, optimise, support the evalutation tests and customers on a sustainable basis, and extrapolations , …

The applicant should be able to demonstrate capability and experience in implementing the associated technologies of capacitor power storage and high reliability modular power control interfaces and systems.

The applicant must be able to utilise and support modelling in specific performance modelling associated with power management modelling and efficienciency (*via SABER).*

3. Major deliverables and schedule

Deliverable	Title	Short Description (if applicable)	Due date (month)
1	List of the converter technology and topology	Report of the converter technology and topology which fulfil the specification requirements	*TO + 3 months*
2	List of possible solutions	Report on the possible solutions including energetic simulation model which fulfil the specification requirements	*T0 + 9 months*
3	Detailed analysis or technology implementation and performance.	Delivery of the detailed analysis including the behavioural simulation of the intended solution	*T0 + 12 Months*
4	Demonstrator and individual test results	Delivery of physical and functional demonstrator and of the individual tests results with the update of the simulation models	*T0+ 24 Months*
5	Integration test results on EDS rig	Integration tests results support and optimisation of the demonstrator to respect system requirements	*T0 + 29 Months* *EDS rig support : 2013 & 2014*

Nota : this list is the minimum deliverables to be provided

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:

€ 500 000 (VAT not applicable)

5. Remarks

- It is expected that the Applicant describes the current technical solution capability and availability that he is aware of and provides some key factors (for a correct technical evaluation).

- All core RTD activities have to be performed by the Applicant. If some subcontracting is included in the proposal, it can only concern external support services for assistance with minor 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)

- if necessary , a consortium can be organize to answer the perimeter of the CFP . In this case, a description of the responsabilities of the participants shall be detailled

The proposal should not exceed a length of 50 pages and include details of the Applicant skills, potential solutions, Work description (work packages & deliveries) , planning (main milestones), risks , management of the project , human resources and budget .

Topic Description Sheet

Topic Nr.	Title		
SP1-JTI-CS-2010-5-GRC03-005	**Adaptation kit design & manufacturing: APU Driving System**	End Date	October 2015
		Start Date	To (04.04.2011)

1. Topic Description

List of acronyms:

AC: Alternating Current
A/C: Aircraft
APU: Auxiliary Power Unit
CfP: Call for Proposal
DC: Direct Current
ETB: Electrical Test Bench
EUT: Equipment Under Test
G: Generator
HMI: Human / Machine Interface
HVDC: High Voltage Direct Current
ITD: Integrated Technology Demonstrator.
JTI: Joint Technology Initiative
RTD: Research, Technology & Development
S/G: Starter/Generator
TBC: To Be Confirmed
TBD: To Be Defined

Background:

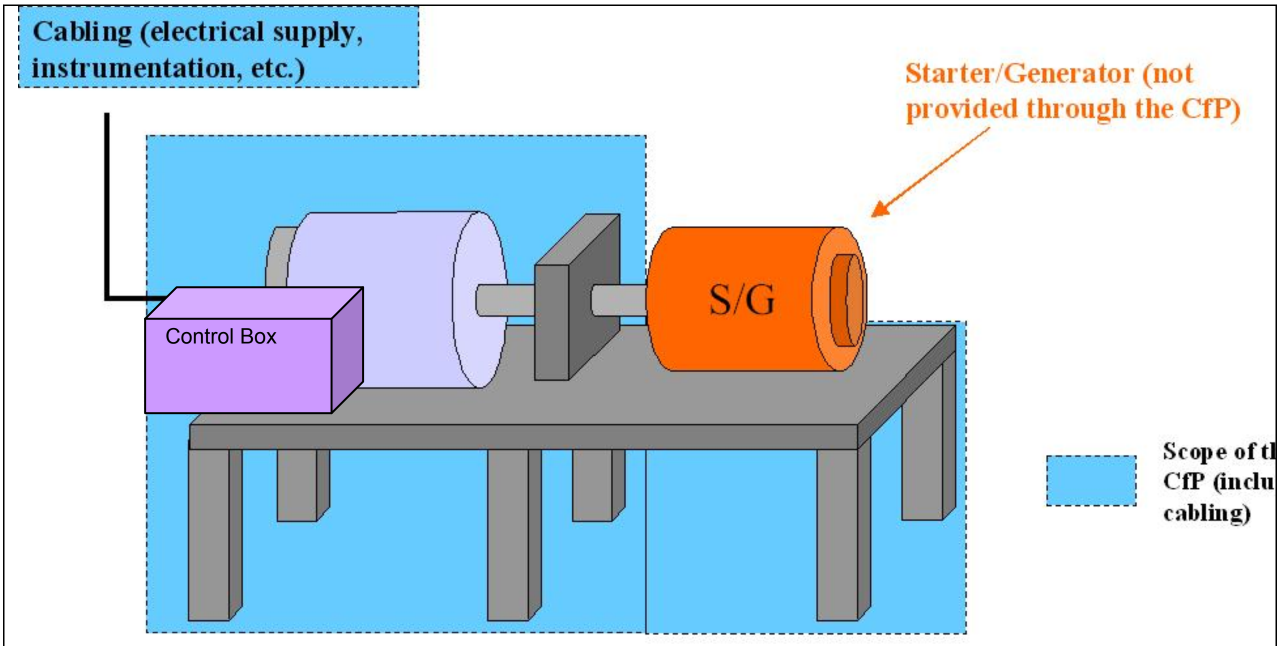
In the frame of the Eco-Design ITD, Verification activities will use an electrical test bench. This Electrical Test Bench (ETB) will support the electrical integration demonstration (generation, distribution, and electrical equipments) and the correlation of numerical models. In association with the aircraft (A/C) Equipments Under Test (EUT) the electrical test bench will have the capability to simulate electrical start of the aircraft engines & APU, as well as electrical generation.

This topic addresses then the aircraft APU simulation function.

Scope of work:

The subject of this call for proposal is the design, manufacturing, acceptance on site & commissioning of a complete driving system for a starter/generator electrical machine: This electrical machine will be a high-speed starter/generator, connected to the A/C APU.

The objective is to provide the mechanical and control means to drive the starter/generator supplied by another member of CLEANSKY. The driving system must be based on reversible driving electrical motors in order to simulate an aircraft APU engine from an electrical generation and starting system point of view.



APU Drive System principle / Scope of the CfP

Technical information:

a) Technical characteristics of the EUT = Starter/Generator:

Starter/Generator:

- Reversible machine (both operated in starter and generator)
- Weight: 19 kg, overhung static moment = 25,2 Nm
- Air cooled by forced air (53g/sec)
- Bearing lubricated by oil (0.2 L/min)
- Mechanical Interfaces to be communicated in further discussion.
- Drive shaft line is horizontal (rationale = S/G local hydraulic circuit shall be oriented as per its A/C installation)

Starting Mode:

- Maximum mechanical torque: 7 N.m from 0 to 5500 rpm
- Maximum mechanical power: 4 kW at 5500 rpm
- Torque variation versus speed: linear between 7 N.m at 5500 rpm and 0 N.m at 28000 rpm
- Start duration: 30s

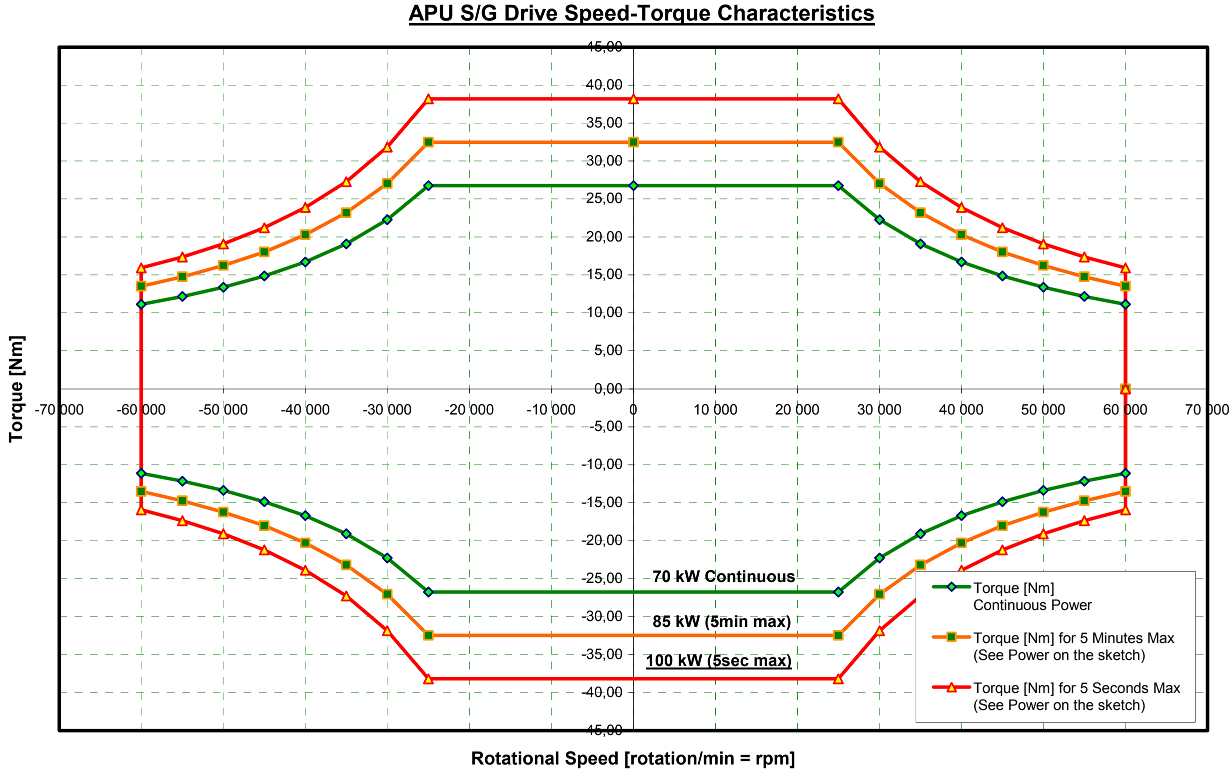
Generating Mode:

- Normal speed range: 48000 – 52000 rpm
- Over speed: 56000 rpm
- Output rectified DC voltage: 270 VDC
- Permanent output power: 50 kW.
- Over Load Capability: 85 kW (5 minutes)
  100 kW (5seconds)

b) Required Capability of the APU S/G Drive System

The driving system must be oversized to be sure to meet overload / over speed / slight modifications of the S/G characteristics during its design phase.

As a design objective, the APU S/G drive shall be capable to reach 60,000 rpm both in generating or motoring mode, in either direction. Operations in the 4 quadrants are required as well as moving from a quadrant to another while testing APU S/G Sequence.



c) Interfaces with the Electrical Test Bench (ETB)

The general Interfaces between the ETB and equipment batches will be provided through a dedicated document to the partner at a later stage of the design activities. However, the following features relative to power and control system are interface constraints relative to the Electrical Test Bench for Cleansky.

With regards to the implementation in the test facilities, the APU S/G Drive will be set in the test hall section. Electrical power (500V (preferably) and 400V), pneumatic connection and cold water connection (TBC) is available in the test hall.

From a control command point of view, the control system shall have a “local” and a “distant” remote control mode.
In the local operating mode, the control and command orders can only be locally generated through the local Human / Machine Interface (HMI).
When in “distant” mode, the APU S/G drive system is remotely controlled from the control room and the Human Machine Interface is reported in the control command room.

Tasks are performed at different rates:

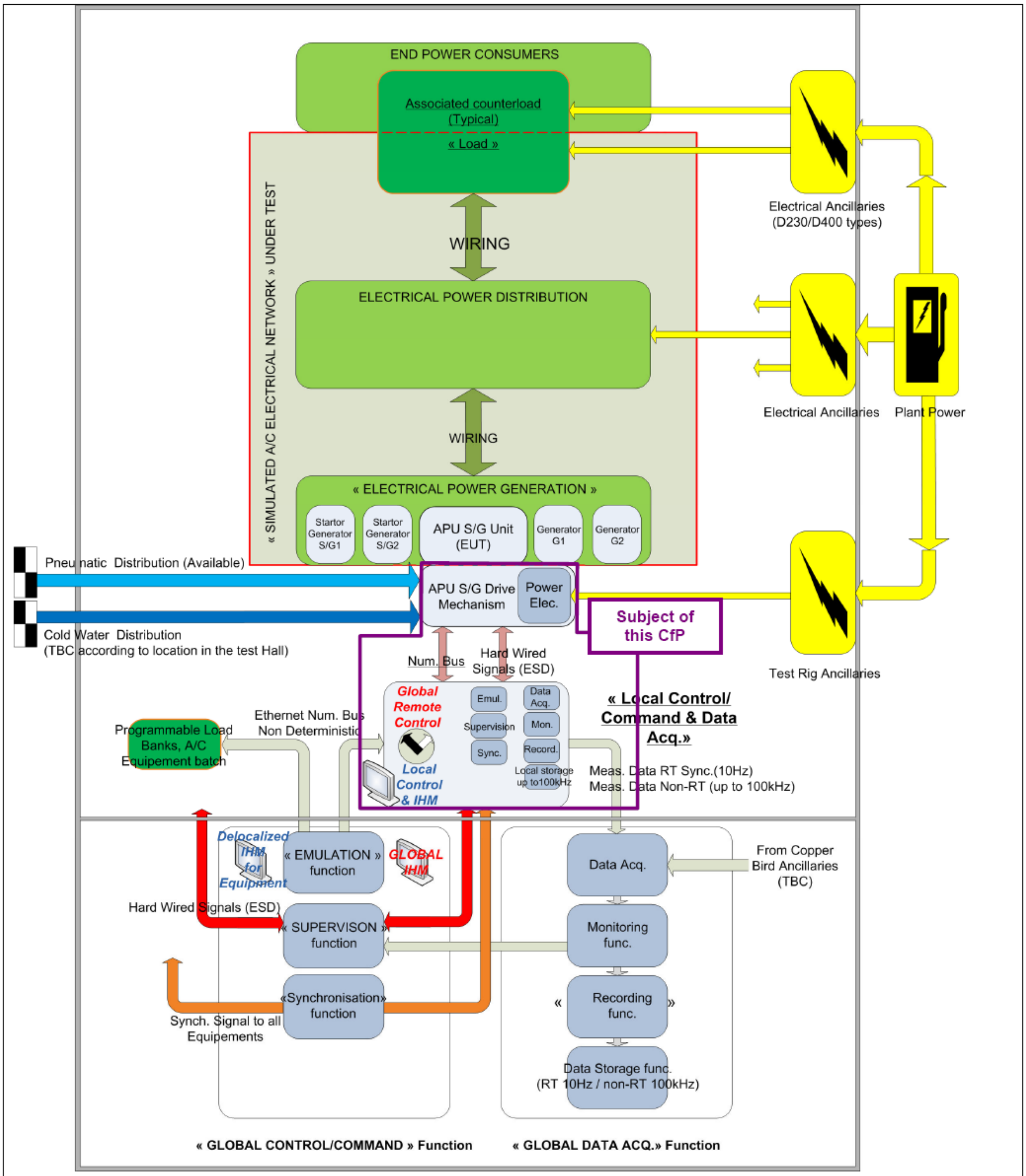
1- Some tasks are accomplished in a fast and deterministic manner:

The local control system manages the safety aspects for the local bench (Safety relays are part of the CfP package as detailed in next paragraph).
The local control system receives set points and commands from the overall bench (when in this mode)
The local system controls the torque or rotational speed with regards to the specified profile.
Synchronise the local bench clock with the overall bench clock.

2- Tasks accomplished in non real time:

Displays the local control panel,
Upload locally recorded data at a fast sampling rate (up to 100kHz) to the overall test bench.

Please note that the detailed interface will be finalized in a later stage and pieces of equipment specifications relative to the control system may be available and supplied to the CfP partner to satisfy the functions above.



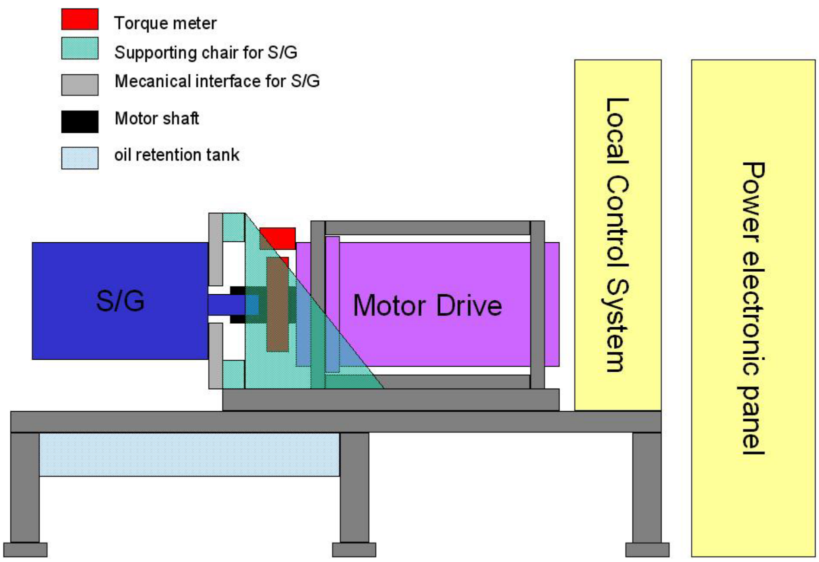
Scope of the CfP in the ETB environment

Scope of the CfP in the ETB environment

d) The drive system supplied through this CfP will include:

- Mechanical driving system (including power electronics & control)
- Torque measurement up to 1000 Hz minimum (initial calibration report included).
- Shaft rotational speed measurement (initial calibration report included).
- Mechanical coupling of the machines.
- System supporting frame. Lifting ring or forklift interfaces are expected for any parts above 30 kg.
- System internal cabling and associated protection.
- Ancillaries if needed (lubrication system, etc.)
- Covers for both drive and EUT.
- The system must be robust to misalignment.
- The drive control system shall be locally and remotely controllable from a separated control room, protecting personnel from the high speed rotating machines.
- The control system shall include speed and torque control mode; it shall allow to have torque at 0 rpm.
- The drive system will transfer data relative to the transducers measurements and also relative to the health status of the system (OK, alarm on selected parameters, default)
- Monitoring of the shaft line (through vibration measurement, temperature for instance) will be included upon Applicant innovative suggestion
- Safety features such as emergency shut down push-button and discrete data transfer to the ETB is included in the topic.
- Control system should display status; automatic actions should be done according to the level of alarms (warning: warn the bench operator who has to take a decision / emergency: automatic shut down procedure to protect people & the installation).
- Safety circuit different from command circuit.
- Maintenance in operating state for the whole system during the project
- Validation of the System when it is coupled with the S/G APU (EUT)
- The transition between the Starting mode and the Generating mode must be done without fits and starts.
- Documents:
    - Detailed documentation (detailed description, operations, protocols)
    - Safety analysis
    - Electrical and mechanical interfaces drawings
    - Maintenance procedures

As an option, a lubrication / cooling unit for the APU S/G with characteristics to be defined shall be provided by the partner.



Typical assembling (as an example)

e) The system will not include:

- Starter / Generator, its dedicated cabling, electronics, control and ancillaries.
- Wiring and interfaces to the ETB

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

The proposal should include:

- Detailed study of the solution
- Manufacturing the system
- Integration and intermediate acceptance testing on CfP Supplier site.
- Commissioning on ETB site of the system as well as support until final acceptance

The system should be innovative, either by the solution, or by technology, materials, control loop design or monitoring. 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.).
- If no reducers/multipliers are used, very high speed (up to 60 000 rpm) direct drive system solutions could be explored.
- Mass optimized

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 drive system for the ETB.

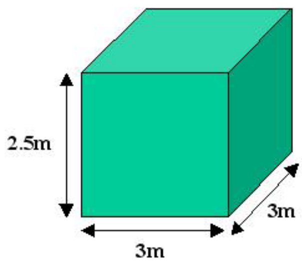
Criteria to meet:

The system will be as compact, robust and optimised as possible: the bench (supporting frame, drive, instrumentation, lubrication system, power electronics, etc.) should be contained in a specific allocated space: 3m x 3m x 2.50m (l x L x h) as a maximum; the 9m² is a total working allocated surface that shall include personnel access to perform the required operations on the equipment or its ancillaries. Those operations are, but may not be limited to:

- Assembly,
- Rigging;
- Maintenance operations.

Operations on a dedicated area/equipment shall not impact another equipment-dedicated area..

The compactness of the proposed solutions will be a selection criteria for the CfP.



Space allocated for the APU drive test bench

- The system will use as few lubrication systems and servitudes as possible.
- The system will require reduced maintenance time, have a low cost of operation and a high level of safety and robustness

The scope of the CfP is design, manufacture, integration and validation of the system.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	PDR	Preliminary Design Review	T0 + 3 month
D2	CDR	Critical Design Review	T0 + 6 month
D3	Manufacturing and delivery	Delivery of the complete systems	T0 + 12 month
D4	Commissioning and acceptance	Acceptance of the complete systems	T0 + 14 month
D5	Maintenance	Maintenance of the APU Drive Bench	October 2015

4. Topic value (€)

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

€ 430,000 --

[Four hundred thirty thousand euro]

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

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)

CfP topic number	Title		
SP1-JTI-CS-2010-5-GRC-04-003	**Integration studies of an optimal Diesel engine matching the ideal light rotorcraft platform characteristics**	End date	30/11/2012
		Start date	01/03/2011

1. Topic Description

Background

The JTI Clean Sky Green Rotorcraft research consortium is aiming at the development of low specific fuel consumption capabilities. These can be obtained by using turbocharged Diesel engine technology developed in the automotive industry integrating this technology on light helicopters to reduce gas emissions levels. The final expectation is to reduce specific fuel consumption and consequently CO_2 emissions.
The topic concerns light helicopter family powered by a single-engine with maximum take-off weight between 1200 and 2000 kg operating up to 6000 m above the sea level and temperature range between -40°C and ISA+35^{0}C. Diesel engine installed in such helicopter should assure the optimal helicopter performances.

The preliminary ideal helicopter characteristics are as follows:

- Static hovering ceiling with ground effect @ 1800kg and ISA condition no lower than: 2000m
- Vmax at Take-Off Power, Sea Level no lower than: 220 km/h
- Climbing at Take-Off Power, Sea Level greater than: 6 m/s
- Minimum range at Sea Level including a reserve of 5%: 750 km
- Cruising speed at Sea Level no lower than: 210 km/h
- Range with reserve for 30 minutes of flight: 700 km
- Flight endurance at best endurance speed no lower than: 5 h
- Helicopter should perform hovering at the height of 1000m without ground effect, with an helicopter weight of 1800kg @ ISA condition

Moreover, in order to fulfill the environmental impact reduction expectations according to the ACARE goals for year 2020, the engine shall have the following characteristics:

- Specific fuel consumption (SFC): not greater than 0.19 kg/kW/h (at output power level ranging from 50 to 100% of max take off rating)
- Weight-to-power ratio: not greater than 0.6 kg/kW (including the weight and power off-take of accessories)
- Time Between Overhaul (TBO): not less than 4000 h

Scope of Work

In the frame of the design activities of an ideal helicopter platform hosting a Diesel engine a specialist support is needed to define the optimal engine characteristics and the integration studies of the related sub-systems. The bilateral objectives are to define both the optimal turbocharged diesel engine and to provide support for the integration studies of it into the ideal helicopter platform, whose design will be developed in parallel. Besides it is requested the evaluation of the environmental impact reduction of such an ideal platform with respect to the one equipped with a turboshaft engine.

Manufacturing of the proposed engine is NOT required.

Tasks

1. Definition of the engine architecture and performance fulfilling the helicopter performance and installation requirements.
2. Characterization of the installation loads and vibration limits that the engine can withstand.
3. Definition of engine sub-systems (oil system, cooling system, electrical system, fuel system, engine to transmission synchronization system, engine cold/hot/in-flight starting system).
4. Thermodynamic analysis of the Diesel engine. Evaluation of the engine heat transfer to the engine bay as well as cooling and ventilation methods, in idle, hovering, climbing, cruise and max velocity conditions.
5. Evaluation of the engine vibration spectrum and analysis of vibration reduction methods. Integration to the main gear reduction unit.
6. Definition of the engine control system (FADEC) and support to the integration studies in the helicopter electrical and avionics systems. Study of the monitoring (caution, warning) for the engine/transmission. Study of the emergency control system (“limp home” system).
7. Support to the integration studies of the engine on the ideal helicopter, including mechanical and electrical/avionic interfaces.
8. Evaluation of the environmental impact of the ideal platform with the optimal Diesel engine.

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

1. Master skill of the aircraft engine design and Diesel engine for aeronautical use.
2. Knowledge of the Diesel engine construction and good know-how in helicopter power drive analysis.
3. Knowledge of the Diesel engine dynamics. Power drive static and dynamic loads analysis skills.
4. Knowledge of the aerodynamics and thermodynamics of the Diesel engine. Abilities to implement advanced thermodynamic models with use of analytical methods to perform heat & flow analyses.
5. Knowledge of the engine control system (FADEC).
6. Knowledge of the vibration reduction methods in mechanical systems.
7. It is recommended for the applicant to mention any previous experience and the analytical tools intended to be used

3. Major deliverables and schedule

The input for starting the activities, i.e. refinement of the information on platform characteristics, will be provided at month T0 through a specific document.

Deliverable	Title	Description (if applicable)	Due date
D1	Engine Specification – Engine General Description	Engine technical specification including: engine architecture description, engine global characteristics (weight, space envelope, power, fuel consumption, TBO, etc.), installation loads, vibration limits, engine performance characteristics.	T_0 + 6
D2	Engine Specification – Subsystems	Definition of all engine sub-systems (oil system, cooling system, electrical system, fuel system, engine to transmission synchronization system, engine cold/hot/in-flight starting system)	T_0 + 10
D3	Engine Specification – Thermodynamic Analysis	Results of study of the engine heat transfer to the engine bay, cooling and ventilation methods.	T_0 + 10
D4	Engine Specification – Engine Vibration Characteristics	Results of study of the engine vibration spectrum and vibration reduction methods.	T_0 + 14
D5	Engine Specification – Engine Control System	Definition of the engine control system (FADEC) and support to the studies of its integration in the helicopter electrical and avionics system.	T_0 + 14
D6	Engine Specification – Interface Control Document	Diesel engine integration studies results.	T_0 + 18
D7	Environmental impact report	Evaluation of the environmental impact of the ideal platform with the optimal Diesel engine	T_0 + 21

4. Topic value (€)

The total value of this work package shall not exceed:

650,000.--€

[Six hundred fifty thousand euro]

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

5. Remarks

Manufacturing of the proposed engine is not required.

Please refer to the separate document provided as part of the Call Text

Clean Sky Joint Undertaking
Call SP1-JTI-CS-2010-05-GRC-06-001

Topic Description

CfP topic number	Title		
JTI-CS-2010-05-GRC-05-004	*Tuning of simplified rotorcraft noise models. Preliminary acoustic measurement test campaign.*	**End date**	T_0 +8 months
		Start date	To

1. Topic Description

<u>1. Background:</u>

In the framework of the "Clean Sky" Green Rotorcraft ITD, and in particular in the sub project GRC5 "Environment-Friendly Flight Paths", a great deal of interest is focused on the minimization of the acoustic impact of helicopter during take-off and landing.

A challenging goal of the project is the implementation of noise minimization algorithms that can be run on-fly and that provide directivities to the on-board flight management system. This functionality would permit, for instance, to minimize the noise at one prescribed ground station during the time-period of a flight procedure. The main interest of this approach is that the directionality of a rotorcraft noise footprint and its sensitivity to the parameters defining the flight status and the trajectory can be exploited to reduce the impact on a noise-sensible area.

To this scope it is mandatory that the acoustic algorithms predict reliable noise levels and accurate noise sensitivity to the flight status and trajectory parameters, and that the algorithms are sufficiently fast for a real-time execution. The use of semi-empirical methods is a viable compromise between accuracy, reliability and rapidity. Semi-empirical methods are by nature theoretical models informed by experimental data in which the models are derived from first principles through a set of simplifications that preserve the trends of the underlying phenomena; the experimental information allows to tune the model parameters.

Helicopter noise exhibits a strong sensitivity to the flight status and trajectory parameters. For this reason, in order to properly inform a theoretical model, a detailed experimental database is required. More specifically, <u>noise signals</u> must be measured at several ground stations distributed over a broadly extended area and along the helicopter flyover/manoeuvre time.

<u>2. Scope of work:</u>

The main objective of the present Call for Proposal is to determine the transfer function between the noise measured close to the helicopter noise sources and the noise signals measured on ground using a grid of microphones to be carried during a flight test campaign.

For this reason the selected Partner shall collaborate with GRC5 Team to analyse the problem in order to reduce or eliminate any incorrect noise measurement and define a *new advanced methodology.*

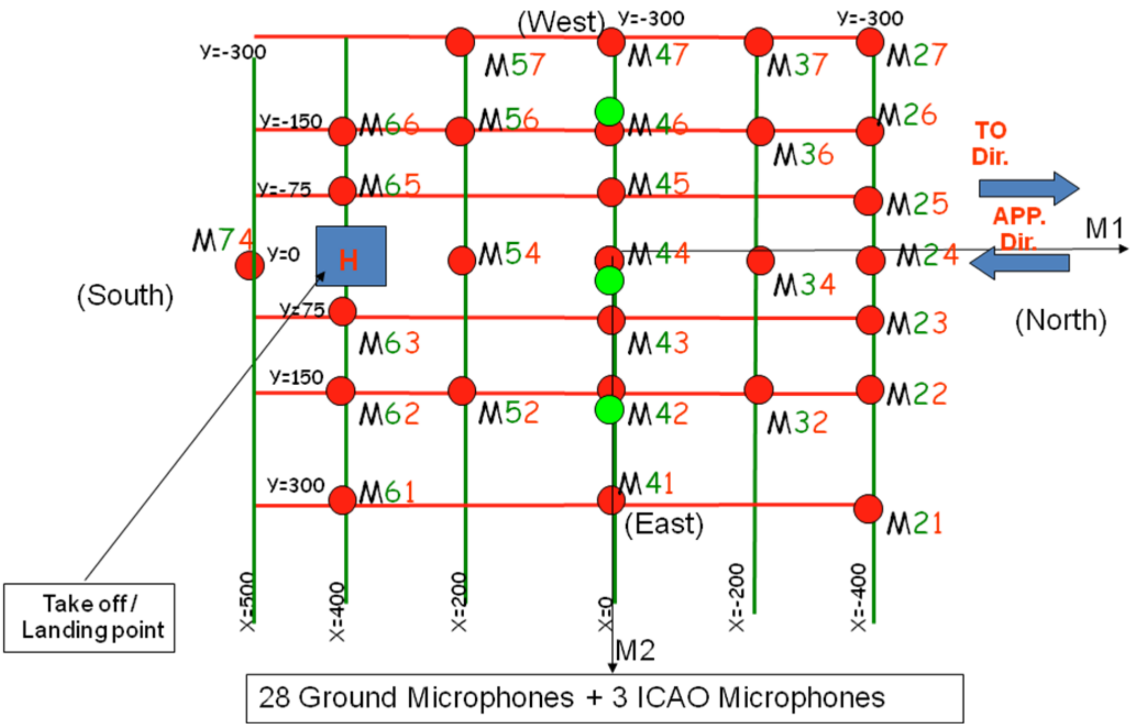
To achieve this goal and before the test campaign, the selected Partner will provide a study to determine the applicability of different types of microphones for this application on the helicopter (i.e. the flat microphone) including their location, in order to avoid or minimize the effect of rotor flow on noise signals. So, it is also required the applicant to complete the full achievement of the noise measurement from the acquisition to the level-1 post-processing of the measured raw data, i.e. signal filtering, spectral analyses, required corrections.

The selected partner will be involved then in the analysis and correlation of the acoustic signals obtained (airborne and ground measurements) to help assess the capability of the methodology to improve the acoustic testing by this different approach (I.e. reduction of ground sensor requirement; use of the helicopter sensors as a complement/integration of the ground-based measurements, etc).

In order to provide sufficient and adequate information for the preparation of the proposal, a preliminary test plan and experimental protocol is outlined in this section. Reviews of the present plan can be made in the future according to specific necessities of the work program and in agreement with all the CfP stakeholders.

The following figure illustrates the layout of the microphone grid to be installed on a flight test area located in the airport of Cameri, in the Northern Italy.

Distances reported in the figure (x,y) are in metres.



Green circles denote microphone located 1.2 m above the ground (ICAO microphones), while red circles denote ground microphone located on rigid plate at the ground level.

In addition to the ground microphones, 3 microphones will be installed on board of the helicopter, and in particular:

- 1 classic ICP microphone with a cone to reduce flow noise installed at the boom (Mic. #1) if it will be possible to install,
- 2 microphones, surface type, in other locations: Mic. #2 located at the cabin door and Mic. #3 at the landing gear sponson. The locations of the microphones in the figure are only a first attempt but a research study is required in order to determine the best position to measure helicopter noise sources not influenced by air turbulence. Moreover, this type of microphone is new and no reference is available on the use of this type of sensor for this application.

Example of the on-board microphones position is shown in the following figure.

The flight test activity will account for both stationary conditions and manoeuvres. <u>For each flight condition, 3 valid runs will be required before moving to the following condition.</u>

SUMMARY OF FLIGHT CONDITIONS

- 28 steady-state conditions
- 3 manoeuvres take-off
- 5 manoeuvres approach
- 4 turns
- 1 ground idle
- 1 Hover in ground effect (HIGE)
- 1 Hover out of ground level (HOGE)

Considering an average value of 5 minutes as the time required to perform one single run ("active+passive" time) provides 600 minutes or **10 hours flight.**

The following tentative time planning will be applied:

- MONDAY: installation of the instrumentation and 1 hour flight probably in the early afternoon.
- TUESDAY: starting test at 10.30, 1.5 h test morning, 1.5 h test afternoon.
- WEDNESDAY: starting test at 10.30, 1.5 h test morning, 1.5 h test afternoon.
- THURSDAY: starting test at 10.30, 1.5 h test morning, 1.5 h test afternoon.
- FRIDAY: half day as backup.

Depending on the weather conditions, an extension to the following week could be required.

At the beginning of each day, microphones will be calibrated and a microphone synchronization test will be carried out.

At the end of each day, raw data will be presented to the AW/CIRA personnel.

SCHEDULE OF MEETINGS AND REVIEW MILESTONES

The following series of meetings and corresponding critical Milestones are defined:

M1 (T0+1)

4 months before the test campaign, technical kick-off Meeting of all partners involved.

M2 (T0+2)

3 months before the test campaign, technical Meeting AW-Partner for integration of HW.

M3 (T0+4)

1 month before the test campaign verification of the test site and definition of a list of actions for the site preparation (cut of the grass, determination of microphone sites, placement of visual cues in the field, etc.)

M4 (T0+5)

Test campaign and preliminary presentation of raw data at the end of each day

M5 (T0+7)

Presentation of the preliminary post-processing data.

M6 (T0+8)

Project closure meeting and presentation of level-1 post-processed data

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

Introduction

Due to the technical complexity of the call and to the particular nature of the activity, the well referenced experience of the applicant in the field of aircraft/rotorcraft noise measurement will be a key element of the selection. In particular, the capability to manage a large number of sensors from the HW point of view, while preserving the reliability and robustness of the acquisition SW to monitor, store in a database and post-process the noise signals are *sinequanone* conditions for the selection.

HW/SW capabilities

The successful Partner will be able to allocate the required hardware (microphones, plates, cables, wireless, acquisition systems, etc.) in adequate quantity (test plan + backup) and for the whole duration of the test (1 week). In addition, the successful Partner will be able to monitor the validity of each run in real-time for all the microphones and to carry out a level-1 post-process of the acquired pressure signals.

Microphones and ground plates

The requirement for the measurement and microphone system, as specified in ICAO Annex 16 Volume 1, is sufficient for these measurements.

Microphone and systems calibration will be made under ICAO constraints.

The microphones will be flush mounted on the ground and at 1.2 m in the three certification points.

The acoustic equipment should be checked by an agreed company in a period less than 6 months from the measurement, as specified by ICAO.

Acquisition chain

As specified in ICAO Annex 16 Volume 1, Appendix 2, Paragraph 3.6.

Sampling frequency

Pressure [Pa] time history recorded at a sampling rate of at least 51.2 kHz, synchronized with GPS Time and 1/3-octave bands as a function of time (0.5 s) as required by ICAO.

Microphone calibration and verification of the acquisition chain

- The sensitivity of each microphone is measured at the beginning of each day (calibration).

- The whole acquisition chain, including the microphone numbering and syncronization, is verified at the beginning of each day using a loud speaker pilot signal, following the best practise of the applicant. The data of this tunign test are stored in the noise database. In order to syncronize the noise time signals with the instantaneous position of the helicopter during flight, the signal time is referred to an external clock absolute time.

Level-1 post-processing capabilities

The raw data (time series of sensor signals) are converted in pressure time signals [Pa] using the microphone sensitivity measured at the beginning of each test day for each microphone. After the flight test activity, the corrections are applied and the Cross-Spectral-Density-Matrix [Pa^2/Hz] involving the 31 ground microphones is computed and stored in the noise database. The third-octave SPL spectra are also computed for all the microphones (31+3+3=34) and stored in the noise database. The algorithm used for the spectral analysis, including the signal windowing, is detailed in the test report.

The method for the determination of the transfer function using on-board and on ground acoustic measurements must be defined.

Meteo tower

The ground meteorological measurements are made in the vicinity of the central microphone, 10 meters above the ground. All the equipments are calibrated prior to the campaign.

SENSOR precision Minimum sampling rate

Pressure < 0.3 hPa 0.1 Hz

Temperature < 0.3°C 0.1 Hz

Humidity < 0.3% rel. Humidity 0.1 Hz

Wind Speed < 0.3 m/s 2 Hz

Wind direction < 3° 2 Hz

If averaging is performed it has to be under ICAO conditions.

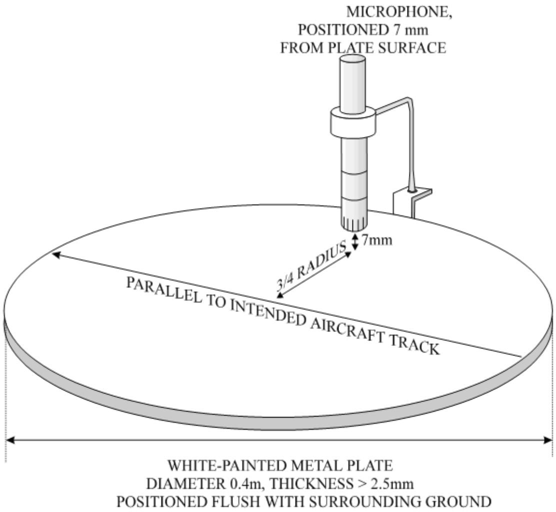
Recommendation: have the meteorological equipment checked by an agreed company in a period less than one year from the measurement, as specified by ICAO.

Radar methods, weather balloon method or equivalent methods

If possible, temperature and relative humidity measurements over the entire sound propagation path between the helicopter flight altitude and a point about 20 meters above the ground should be considered.

Rigid plates

Microphones on the ground must be mounted in the inverted position over a 40cm diameter, white-painted metal plate, 7mm from the plate surface oriented at grazing incidence to the planned flight path.



Generic capabilities required vs expected results

On site activity with an adeguate logistics.

3. Major deliverables and schedule

Deliverable	Title	Short Description (if applicable)	Due date (month)
D01	Study of the applicability of surface microphones for on-board acoustic measurement and determination of best location in the helicopter.	Determination of available frequency range for helicopter aeroacoustics, compatibility with acoustic signal amplitude, installation set-up etc. Determination of the locations for installation giving the characteristics of noise sources not contaminated by rotor and flight turbulence.	T_0 + 4M
D02	Raw data and repository description	Raw data (noise time histories) for each microphone and for all the runs (3 per flight condition) and an accompanying document describing the noise database. The data of the microphone synchronization tests are also stored in the repository.	T_0 + 7M
D03	Test report, post-processed data and transfer function determination.	The noise database including the post-processing data and a complete test report describing the whole database and the conducted level-1 post processing TF included.	T_0 + 8M

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:

€ 300 000/00

[three hundred thousand European Commission]

(VAT not applicable)

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 maximum length of the technical proposal is 50 pages.

Clean Sky Joint Undertaking
Call SP1-JTI-CS-2010-05-GRC-06-001

Topic Description

CfP topic number	Title		
JTI-CS-2010-05-GRC-06-001	Manufacturing of a Thermoplastic Composite Feasibility Article for a Helicopter Door	**End date**	T0 + 18 M
		Start date	T0

1. Topic Description

Background:

The objective of the Green Rotorcraft Workpackage (GRC WP) 6 is to demonstrate eco-friendly processes for specific helicopter components, based on innovative processes developed in the CleanSky EcoDesign ITD. One of the processes in the EcoDesign Airframe ITD is based on the development of thermoplastic composite (TPC) customised blanks (near-net-shaped blanks consisting of several layers with optimised fibre directions –unidirectional and/or woven fabric-) that can be later formed, integrated and consolidated into high quality aerospace parts. Thermoplastic composites present significant ecological advantages over thermoset composites in terms of process cycle time, recyclability, waste, and storage.

The aim of GRC WP6.1 is to demonstrate mentioned process on a full-size helicopter door structure made of thermoplastic composites. One significant step is the final consolidation of the integrated structure consisting of customised blanks, preconsolidated structures and moulded parts (skin and inner module with fittings). Currently, this can be achieved by the resource -time and energy-consuming autoclave curing technology. However, to further reduce the environmental impact of the door's life cycle, the final consolidation step for the door is preferably based on a novel out-of-autoclave technology. This call therefore aims to identify and investigate an environmentally-friendly final consolidation technology and to demonstrate this 'green' final consolidation step by manufacturing a thermoplastic composite helicopter door section (feasibility article).

Scope of work:

The applicant is responsible for the following tasks:

- Identify and investigate an environmentally friendly final consolidation technology for the customised blanks, fittings and pre-consolidated parts. The technology shall be selected based on ecological aspects in order to reduce the environmental impact of the helicopter door, while maintaining cost-efficiency. For example, the technology shall be proven to require less resources, such as water, energy and ancilliary materials than the state-of-art thermoset prepreg autoclave technology.
- Screening and definition of the process conditions and process windows for selected materials.
- Assess the final consolidation step by investigating the properties of the resulting parts (mechanical properties, such as interface shear properties (GIc, GIIc, ILSS), damage tolerance, and interface quality, such as microscopy of cross sections, non-destructive testing, etc).
- The process should be demonstrated on technology validation (feasibility) articles (to be specified with partner), including:
    - development of tooling for the feasibility articles, e.g. to demonstrate post-consolidation of customised blanks and co-consolidation of pre-consolidated parts/fittings to the customised blanks.
    - acquisition of toolings and sub-components,
    - manufacturing and validation of the feasibility articles.
- Supply of input data for Life Cycle Analysis tools.

The generic lay-up and materials for testing will be provided.

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

The applicant (single organisation or a consortium) should dispose of the following facilities and knowledge:

- Strong knowledge on thermoplastic polymer based composites (knowledge on high performance thermoplastic composites, such as carbon fibres with PPS, PEI, PEEK, PEKK would be considered an asset)
- Experience to handle woven as well as unidirectionally reinforced TPCs
- Extensive experience and (research) capabilities for manufacturing thermoplastic composite structures, including welding and/or (post-)consolidation, and experience in process optimisation and innovations.
- Extensive experience and capabilities for characterising thermoplastic composites, testing of coupons, parts and joints (mechanical and physical properties)
- Ability to operate within aeronautical quality procedures
- Understanding of Life Cycle Analysis (LCA) tools, capabillity to deliver input for LCAs

3. Major deliverables and schedule

Deliverable	Title	Short Description (if applicable)	Due date (month)
D1	Technology screening test methodology	Propose test methods for screening, preliminary trials, optimisation (report with argumentation, including environmental aspects)	T0 + 3 (months)
D2	Development of manufacturing processes	Physical proof of concept	T0 + 6
D3	Report with screening results and analysis	Selection of technology for final consolidation step	T0 + 8
D4	Definition of process parameters	Report with process parameters, conditions, boundaries	T0 + 10
D5	Test matrix for material property testing	Specified together with partner	T0 + 9
D6	Test report on material properties	With results of D5	T0+15
D7	Tooling design for feasibility articles	Detailed drawings available	T0 + 9
D8	Tooling for feasibility articles	Toolings available	T0 + 12
D9	Feasibility articles	Hardware/ product available, incl. report with manufacturing parameters	T0 + 15
D10	Validation of feasibility articles	Report with properties, environmental parameters, results, analysis and validation of test articles available	T0 + 18
D11	Delivery of all LCA relevant input data regarding manufacturing process	Report covering LCA input data and suggestions for industrial planning	T0 + 18

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:

€ 200 000.00 (VAT not applicable)

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 maximum length of the technical proposal is 20 pages.

Clean Sky Joint Undertaking
Call SP1-JTI-CS-2010-05-GRC-06-002

Topic Description

CfP topic number	Title		
JTI-CS-2010-05-GRC-06-002	Manufacturing of Thermoplastic Structural Demonstrators	End date	T0 + 28M
		Start date	T0

1. Topic Description

Short description

The main targets of this CfP are the Design support, Manufacturing, Joining technology selection, NDI (Non Destructive Inspections), Mechanical characterisation and Certification support for the following new Thermoplastic Structural components

- Upper Panel Rear Fuselage Demonstrator
- Sponson Fairing Demonstrator
- Radome Demonstrator

Proven aerospace thermoplastic expertise from external companies or consortiums is then required to achieve the most ecolonomic design and manufacturing technologies.

1. Background:

Green Rotorcraft Consortium 6 (Grc 6) Objective Is To Demonstrate Eco-Friendly Life Cycle Processes For Specific Helicopter Components, In Continuity And Complementarity With The Generic Processes Demonstrated In The Ecodesign Itd.
Grc 6 Strategy Is To Manufacture And Test Typical Rotorcraft Components, Then To Assess Impact According To Ecoquotation Method Established In Eco-Design Itd (Ed).

The work described here relates to the development of technology demonstrators for rotorcraft based on activities performed within the Eco Design ITD.

Two main areas have been identified during the preparation phase of Clean Sky: “Airframe components” and “Transmission components”.

Within “Airframe components”, the main targets of this CfP are the Design support, Manufacturing, Joining technology selection, NDI, Mechanical characterisation for the following new Thermoplastic Structural components

- Upper Panel Rear Fuselage Demonstrator
- Sponson Fairing Demonstrator
- Radome Demonstrator

In order to achieve the most ecolonomic design and manufacturing technologies according to ecoquotation method established in Eco-Design ITD (ED).

A Technology Readiness Level TRL6 will be achieved.

The Green Rotorcraft Consortium, with lead guidance provided by The Topic Manager, request bids from companies or consortiums to provide their specific expertise and support in Design, Manufacturing, Joining Technologies, NDI and Mechanical characterisation for the proposed components.

2. Scope of work:

The Green Rotorcraft Consortium members wish to engage with a company (or consortium) who will provide the existing Green Rotorcraft Consortium members with sound expertise for the Design, Manufacturing, Joining technologies selection, NDI, Mechanical characterisation of the following Thermoplastic Structural components

- Upper Panel Rear Fuselage Demonstrator
- Sponson Fairing Demonstrator
- Radome Demonstrator

in order to achieve the most ecolonomic design and manufacturing technologies.

Design

Designing with thermoplastic composites calls for knowledge of the material properties and of the production process.
New concepts for design and manufacturing of constructive details will also require engineering data in a wide range of (also environmental) loading conditions.

Applicants will provide the knowledge (scientific understanding + test methodology) required for Aerospace thermoplastic composite design.
The design activity shall start from an existing design based on traditional materials (Termoset Composites).
The existing design and the relevant functional specifications shall be the starting point for the development with thermoplastic material.

Manufacturing

Applicant shall be equipped to produce thermoplastic composites from coupon-like specimens to large substructures and shall provide the following new Thermoplastic Structural components as deliverables:

- Upper Panel Rear Fuselage Demonstrator (1 part)
- Sponson Fairing Demonstrator (1 part)
- Radome Demonstrator (1 part)

Advanced joining methods of thermoplastic materials

Applicant shall indicate the proper joint selection among resistance, induction and ultrasonic welding of the proposed thermoplastic composite structures.

NDI (Non Destructive Inspection)

For all the items, Applicant shall provide an NDI Development Plan and NDI results.
NDI have to be carried out for each item 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.

Performances and Mechanical characterization

Applicant is required to provide all the standard mechanical properties (Tensile / Shear / Compression Strength or Modulus) at various environmental conditions (Room Temperature Dry, Hot and Wet) for the manufactured demonstrators.

The process-related material behavior (fabric deformation during processing, laminate-tool interaction…) or structural performance related (damage model…) shall also be investigated.

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

The applicant must have the professional skills and qualifications (technical and managerial) required for completing the proposed action and the capacity to manage an activity of the scale and size of the action.

Applicants must have all the professional (proven aerospace thermoplastic expertise) and technical (Thermoplastic Hot Press Equipments, NDI Equipments, Induction/Resistance Welding Equipments,..) capacity as well as the operational and managerial capability to complete the action proposed and shall provide supporting documents (e.g. description of the expertise among those responsible for carrying out the action with a clear reference to their responsibilities in the project, description of projects and activities related to the action undertaken in the last three years, etc.).

Applicants should have a sound knowledge of the Composite Materials for Aerospace applications.

Applicants should have experience from participation in international aerospace R&T and R&D research projects.

Applicant is required to sign specific Non Disclosure Agreements to facilitate the release of essential information from the GRC 6 Consortium Topic Manager.

3. Major deliverables and schedule

At the beginning of the project, the Consortium will provide the applicant with the following inputs:

1) Drawings of the original components
2) Design Requirements
3) Technical Specifications

A dedicated Meeting involving Consortium and the Applicant specialists will be arranged to discuss the released input documentation and the required deliverables.

Deliverables			
Ref. No.	**Title - Description**	**Type**	**Due Date**
GRC-D6.2.1a	Aerospace Thermoplastics Design Guidelines	Document	T0 + 4M
GRC-D6.2.1b	Aerospace Thermoplastics Technology Practices	Document	T0 + 4M
GRC-D6.2.1c	Aerospace Thermoplastics Material Selection	Document	T0 + 4M
GRC-D6.2.1d	Aerospace Thermoplastics Tooling Design/Manufacturing	Document	T0 + 7M
GRC-D6.2.1e	Aerospace Thermoplastics Joining Technologies Selection	Document	T0 + 9M
GRC-D6.2.1f	Aerospace Thermoplastics NDI Development Plan	Document	T0 + 11M
GRC-D6.2.1g	Aerospace Thermoplastics Certification Roadmap	Document	T0 + 13M
GRC-D6.2.2a	Demonstrators Delivery	Hardware	T0 + 15M
GRC-D6.2.3a	Plan for component testing based on requirements (Test matrix)	Document	T0 + 9M
GRC-D6.2.3b	Analysis of test results against requirements (Evaluation & validation results)	Document	T0 + 27M

Definition of terms:

NDA	Non Disclosure Agreement
GRC	Green Rotorcraft Consortium
NDI	Non Destructive Inspections

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:

€ 200 000 (VAT not applicable)

[two 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 maximum length of the technical proposal is 25 pages with individual chapters for each of the key elements a) to e) defined in the scope of work.

Clean Sky - Sustainable and Green Engines

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	**4**	**5.400.000**	**4.050.000**
JTI-CS-SAGE-01	*Area-01 - Geared Open Rotor*		**0**	
JTI-CS-SAGE-02	*Area-02 - Direct Drive Open Rotor*		**0**	
JTI-CS-SAGE-03	*Area-03 - Large 3-shaft turbofan*		**2.600.000**	
JTI-CS-2010-5-SAGE-03-007	Large 3-shaft Demonstrator – Core Turbomachinery – High Temperature Flexible PCB		600.000	
JTI-CS-2010-5-SAGE-03-008	Large 3-shaft Demonstrator – Structural Surface Cooler development		2.000.000	
JTI-CS-SAGE-04	*Area-04 - Geared Turbofan*		**2.800.000**	
JTI-CS-2010-5-SAGE-04-002	Development of Innovative SLM-Machinery for High Temperature Aero Engine Applications		1.800.000	
JTI-CS-2010-5-SAGE-04-007	Development of Selective Laser Melting (SLM) Simulation tool for Aero Engine applications		1.000.000	
JTI-CS-SAGE-05	*Area-05 - Turboshaft*		**0**	

Topic Description

CfP topic number	Title		
JTI-CS-2010-5-SAGE-03-007	**Large 3-shaft Demonstrator – Core Turbomachinery – High Temperature Flexible Printed Circuit Board**	**Start date**	*Apr 2011*
		End date	*Dec 2013*

1. Topic Description

SAGE3 project aims at development and demonstration of a large 3-shaft bypass engine Demonstrator. The technological challenge is to increase the level of control on the engine core without the burden of heavy interconnection systems.

In this context, RTD activities are foreseen on developing a high temperature flexible Printed Circuit Board (PCB) material to allow control and integrated interconnect systems to be introduced onto the engine core, with the objective to demonstrate this technology to Technology Readiness Level (TRL)6.

The minimum temperature capability of interest is 260°C, but technologies capable of higher temperatures (up to 400°C) would be strongly preferred.

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 High Temperature design & validation

The design of the high temperature interconnect system will be carried out by Rolls-Royce. However the manufacturing partner is required to support this activity to ensure the design is realisable. The types of signals to be carried is outlined in Figure 1 below, a more detailed specification will be supplied during the design phase. The following activities are required:

- Support, from early phases of high temperature flexible PCB system design, through to material and process development. This includes where possible the flexible PCB, the interconnect and the integration of the system. If the interconnect or integration part of this proposal is not within the scope of the proposal this should be clearly stated.
- Develop the design specification and assist in definition both the electrical and mechanical limitations. 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 high temperature flexible PCB.
- As well as providing manufactured articles (see task 3) define and conduct the validation tests required to achieve TRL6 and conduct reviews to verify that the required maturity has been reached.
- Hardware should be capable of being produced to achieve full-scale requirements that would suitable for demonstration on the core of a Trent 1000, should the verification strategy or manufacturing proving strategy so require.

Task 2: Identification, Selection and Development of Materials and Manufacturing Processes for High Temperature PCB

The design and resulting manufacturing methods for the high temperature flexible PCB is a result of the programme, but it is anticipated that high temperature pressing, assembly and inspection technologies (e.g. bonding and NDE techniques) will be key.

- Supported by Rolls-Royce, identify suitable materials and manufacturing processes for the high temperature flexible PCB.
- 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 high temperature flexible PCB.
- Develop the manufacturing processes to ensure that the resulting high temperature flexible PCB 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 high temperature flexible PCBs will be produced, the quality and cost implications of the processes for volume supply should be considered by the partner.

Task 3 : Manufacturing of High Temperature Flexible PCBs

- Develop and design suitable tooling for the PCB manufacture. Procure the required tooling and any bought-in parts.
- Manufacture and supply to Rolls-Royce full-size high temperature flexible PCBs for engine and rig running plus spares to demonstrate core zone 2 and zone 3 capability (about 15 PCBs in total with lengths of up to 5m).
- Provide documentation associated with the process control and inspection of the high temperature flexible PCB to support the validation of the high temperature flexible PCB in task 1.

Figure 1: Outline of Signal Requirments

Signal	Description	Signal Range	Signal Frequency	Source Impedance	Cable and Sensor Impedance
Thermocouple	Low Level DC	2.032mV – 48.838mV typical	dc	High – diff amp	<=50Ω resistive
AFDX	High Speed Controlled Impedance	+/-2.5V pulse differential	10 base-T	100Ω	100Ω
Speed Probe	High Voltage AC	0-300V pk-pk	100Hz – 20kHz	100kΩ differential	1 - 1000Ω resistive
Solenoid	High Power Digital	31.6Vdc to 50Vdc supply variation tolerated. Pull-in Current 150mA, Hold-in Current 100mA, Drop-out Current <5mA. Current drive output 7.8 to 250mA nominal, up to 500mA fault current.	3.12kHz PWM	2Ω	25 – 150Ω resistive

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

Extensive experience in the detail design, development and manufacture of high temperature PCB laminate materials for high performance 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 parts is an asset. Availability of technologies at an high readiness level to minimise programme risks is an asset.

Experience in R&T and R&D programs. Experience of aerospace applications would be an advantage.

The partner needs to be in the position to have access to the manufacturing facilities suitable for making full scale PCB.

The partner needs to have access to rig test facilities for vibration & thermal endurance testing.

The activity will be managed with a Phase & Gate approach and management plan has to be provided. The Topic Manager will approve gates and authorise progress to subsequent phases. Technical/program documentation, including planning, drawings, manufacturing and inspection reports, must be made available to The Topic Manager.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.1	High temperature PCB PDR	Preliminary Design Review	Oct 2011
D1.2	High temperature PCB CDR	Critical Design Review	Apr 2012
D1.3	Capability Readiness Review documentation	Documentation suitable to demonstrate that TRL=6 has been reached	Oct 2013
D2.1	Documentation to substantiate lab development of PCB's.	Analysis report of preliminary manufacturing development suitable to demonstrate ability to manufacture full-size parts.	March 2012
D2.2	Quality plans	Documentation to underwrite the manufacturing of quality parts	June 2012
D2.3	Documentation to substantiate full-size PCB manufacture	Analysis report of final high temp PCB manufacturing and inspection suitable to prove key attributes have been reached.	Sept 2012
D3.1	Manufacturing articles for engine fit checks & or engine test	Delivery of approx 15 high temperature flexible PCB and associated conformance documents.	Oct 2012

4. Topic value (€)

600,000 € **[six hundred thousand 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. Note that VAT is not an eligible cost in the context of this RTD activity.

5. Remarks

If applicable

Topic Description

CfP topic number	Title		
JTI-CS-2010-5-SAGE-03-008	**Large 3-shaft Demonstrator – Structural Surface Cooler development**	**Start date**	*April 2011*
		End date	*June 2013*

1. Topic Description

SAGE3 project aims are the development and demonstration of a large 3-shaft bypass engine Demonstrator. Surface Coolers are an integral feature of advanced turbofan engine designs. They contribute to achieving the best engine performance by maintaining oil and fuel temperatures within defined limits whilst obviating the need for additional ducting of air and a control valve to switch the air on/off. The lack of ducting and control valve leads to an overall cost and weight reduction. Oil and/or fuel is cooled by the passage of cool engine bypass flow over the air washed surface of the heat exchanger.

Current Surface Coolers are parasitic to the existing engine structure, and occupy surfaces that can also be used for acoustic treatment to control engine noise. As such the weight, volume and efficiency of the Surface Cooler are all of great importance.

Compact and light weight surface cooler installations contribute to the efficiency of the powerplant by providing the necessary oil cooling at minimum overall weight and hence optimal fuel burn.

In this context, RTD activities are foreseen, to develop, design and manufacture a Surface Cooler that is structural (i.e. it can carry pressure and thermal loads) to be fitted on the inner surface of the bypass duct.

It is envisaged that such a Surface Cooler would employ novel structural design, advanced manufacturing techniques and potentially novel heat exchanger materials.

The partner shall in particular perform the following tasks:

Task 1: Design & Optimisation of a core mounted structural heat exchanger

Use design optimisation techniques, using CFD and FEA modelling, to achieve high performance, high strength and low cost heat transfer geometries.

Support trade studies to optimise the cooler installation at powerplant level.

Design the test articles which will replace a core fairing on the Trent 1000 based ALPS demonstrator and will be used to cool engine oil. The size of the test article is given in the figures below.

Preliminary major design parameters are given here, detailed specification will be supplied during the design phase:

a. max oil temperature 205°C

b. max oil pressure 650 psig.

c. 500 hours and 2000 pressure cycles (for test article, a production solution would require in the order of 70,000 cycles)

d. cooler needs to be self purging

e. a drainage feature is required

f. as the cooler forms part of the core zone firewall, it needs to capable of demonstration to be fireproof

Task 2: Manufacture of Surface Coolers for validation tests

Develop manufacturing techniques for new optimised surface cooler geometries.

Manufacture test articles (see Task 3 below). One cooler is required for the engine test and will include the seals and the provision & fitting of required test instrumentation. Rolls-Royce will provide the cooler mounting hardware.

Propose manufacturing methods for high volume production of structural surface coolers.

Task 3: Validation of Structural Surface coolers

Provide cooler validation plan including all partner rig validation and the tests/ measurements requested on the Rolls-Royce engine demonstrator.

Prior to engine running, the following tests are required and are the responsibility of the surface cooler partner:

a. cyclic pressure test

b. ultimate & proof pressure tests

c. vibration to DO160E

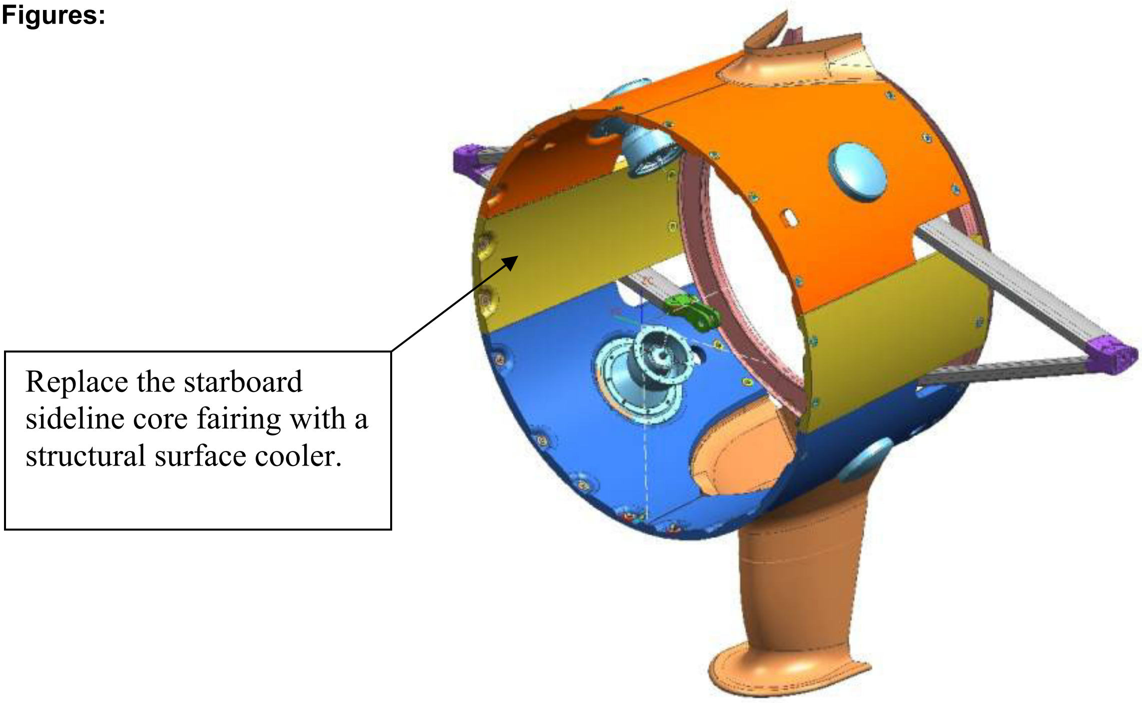
d. heat dissipation performance

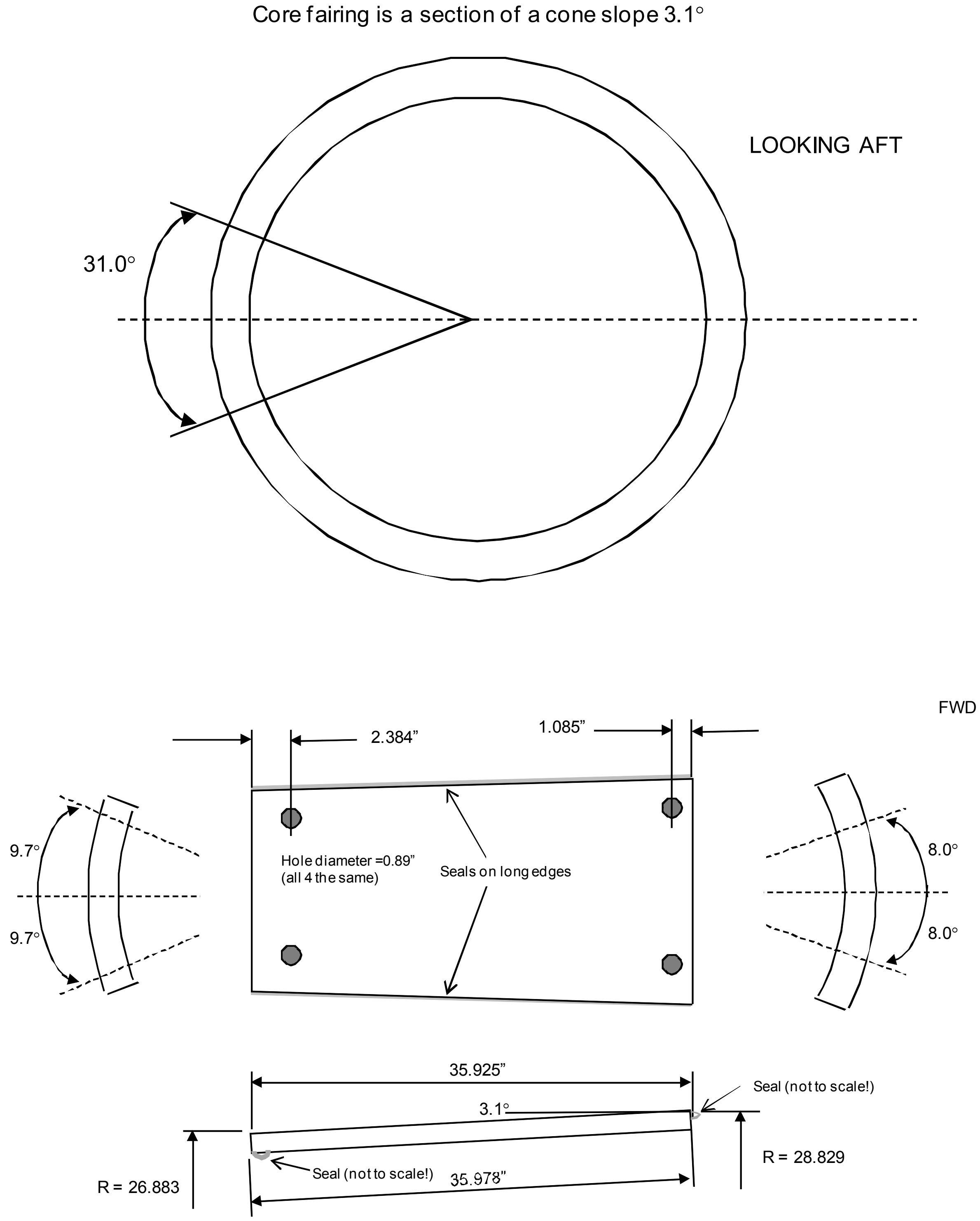
Provide appropriate conformance documents with the test article.

Support the ALPS demonstrator engine test.

Analyse both rig and engine test data and provide validation reports to obtain TRL6.

Figures:





Depth of core fairing typically 1.3”. Fins may extend above the current aeroline.
The depth is reduced locally to the forward attachments to 0.735” by using local pan-downs
For structural surface coolers, propose that the cooler section starts approx 3” aft of the leading edge

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

Extensive experience in the detail design, development and manufacture of heat exchangers for 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 a 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 the Topic Manager.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.1	Concept Design & Validation Strategy Review	Agree concept to take forward to design and the validation route.	Aug 2011
D1.2	Preliminary Design Review (PDR)	Review of concept design including adherence to specification	Dec 2011
D1.3	Critical Design Review (CDR)	Detail design review	Apr 2012
D2.1	Manufacturing Design definition statement	Manufacturing report underwriting suitability of final design for manufacture	Apr 2012
D2.2	Quality plans	Documentation to underwrite the manufacturing of quality parts	Apr 2012
D2.3	Manufacturing & delivery of articles for test	Delivery of test article and associated conformance documents.	Dec 2012
D3.1	Provide cooler validation plan		Aug 2011
D3.2	Complete rig validation of structural surface coolers		Feb 2013
D3.3	Capability Readiness Review documentation	Documentation suitable to demonstrate that TRL=6 has been reached	Apr 2013

4. Topic value (€)

2,000,000 €
[two millions 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. Note that VAT is not an eligible cost in the context of this RTD activity.

5. Remarks

If applicable

Topic Description

CfP topic number	Title		
JTI-CS-2010-04-SAGE-04-002	**Development of Innovative SLM-Machinery for High Temperature Aero Engine Applications**	**Start date**	*T0*
		End date	*T0 + 36M*

1. Topic Description

A first generation of geared turbofan engine (GTF) technology has found its way into the regional and narrow body market due to significant reductions in fuel consumption and noise compared to conventional turbo fan engines.

The purpose of the advanced GTF demonstrator as part of the Sustainable and Green Engine (SAGE) platform is to further advance these technologies and to achieve a next step change in fuel burn reduction combined with an additional decrease in noise emission. Components and modules with new technologies are to be developed, implemented and validated through rig testing as required before integration into a donor engine and SAGE4 full engine demonstration. The successful validation of technologies for this aircraft engine concept will then facilitate the early introduction of innovative new products into the market, and significantly reduce the environmental impact of air transport.

In order to answer the needs of the SAGE4 geared turbofan in terms of research, technological development and demonstration activities, it is planned to offer individual tasks to the industry, universities or any legal entity. Therefore, the present Call for Proposal supports the further development of manufacturing methods with a high optimization potential to allow alternate designs of environment-friendly aero-engine components, fabricated by means of an additive manufacturing process.

The overall aim of this present Call for Proposal is to utilize the existing knowledge and know how of the state-of-the-art powder bed SLM process and to develop the ability of the potential CLEAN SKY partner to manufacture aero engine parts in a larger size as it is possible today and in a quality that is adequate to incorporate the units into the SAGE4 GTF Demonstrator Engine. The objective of this Call is limited to two Nickel based alloys The quality of the parts is mature enough to launch a short term serial production (TRL-6).

MERLIN, another substantial FP7 project addresses complementarily to this CfP topic research activities at TRL3-4 to develop and evaluate various methods of the Additive Manufacturing Process applying a broad variety of materials. The more fundamental approach of MERLIN should provides important information that could be used to further improve the powder bed SLM process at a later stage.

Selective Laser Melting (SLM) or Direct Metal Laser Sintering (DMLS) are additive manufacturing processes of joining powder materials layer by layer to build objects from 3D model data. These processes offer the possibility to change a manufacturing driven design to a design driven manufacturing and therefore building bionically shaped parts optimized in weight and function.

These very attractive processes for aerospace applications require the machinery to be adapted for the demands of aero engine parts. Therefore, the main task for the partners is to develop a SLM/DMLS machine which is capable to built aero engine parts of highly heat resisting and light weight superalloys, and at the same time it is suitable for series production.

Future SLM/DMLS machines have to be capable of the following:

Requirement 1: Adequate part quality and volume

Some high temperature resistant nickel based alloys used in aero engines are weldable only if applying some special treatment. The steep temperature gradients between melting pool and surrounding area lead to not acceptable cracks. For this reason, to build parts made of these materials by SLM/DMLS the environmental temperature has to be sufficiently high. The development with respect to this call is focused on the alloys IN718 and MAR M247.

Another important short-term requirement is to provide a powder bed volume including special treatment that allows to produce engine parts in the order of 350 mm in diameter and 300 mm in hight like small sized casings or rings. Midterm ambition should be the ability to produce medium sized parts.

Requirement 2: High degree of automation, productivity and operational safety

From the economical point of view the most important characteristic is the productivity. It increases with the degree of automation of the process chain (powder supply/recycling, part cleaning/removal, post-processing) and build up rate of the machine.

Besides productivity, the occupational health and safety standard of an industrial applicable machine has the highest priority. Especially when handling with hazardous powder of superalloys, it is required the development of systems that ensure operational safety for the operator.

Requirement 3: Producibility of high surface quality

Once the first parts fabricated by SLM/DMLS are qualified and approved for aerospace applicability, the post-processing steps will have to be minimized. The surface quality of the fabricated parts should be sufficiently high and should be suitable for high aerodynamic requirements, in order to avoid further surface finishing by milling and/or grinding.

Requirement 4: Modular machine concept:

Some light weight materials show critical decrease concerning stationary and dynamic properties, if they are worked under specific atmosphere. In this context, it is desirable that a machine enables not only changing process gas, but also offers the possibility to build parts under vacuum conditions.

It is also important to have the ability to use multibeam in order to enhance the productivity. Another economical aspect is a variable size of the build chamber. This will allow the adaptation of the amount of powder depending on the part size.

To meet all the mentioned demands, future SLM/DMLS machines should have a modular concept which allows that equipment and utilities can be adapted to different applications.

Requirement 5: Online process control

The most important process characteristics in series production are stability and reproducibility. Hence online process monitoring with output information suited for quality management of aerospace parts will be essential in future machines.

The next step after implementation of monitoring systems will be a closed loop online process control to avoid defects in the aero-engine part during the SLM/DMLS process.

The proposal of the applicant has to include realizable values for every given requirement of the SLM/DMLS-machine to be developed and a solid approach to develop the future SLM/DMLS machine with the given requirements.

Based on the given requirements, the partners work includes the following tasks:

Task 1: Management

Organisation:

– The partner shall nominate a team dedicated to the project and should inform MTU AeroEngines project manager about the name/names of this key staff. At least the responsibility of the following functions shall be clearly addressed: Program (single point contact with MTU AeroEngine), Technics & Quality.

Time Schedule & Workpackage Description:

– The partner is working to the agreed time-schedule & workpackage description.

– Both, the time-schedule and the workpackage description laid out in this Call shall be further detailed as required and agreed at the beginning of the project.

Progress Reporting & Reviews:

– Quarterly progress reports in writing shall be provided by the partner, referring to all agreed workpackages, technical achievement, time schedule, potential risks and proposal for risk mitigation.

– Regular coordination meetings shall be installed (preferred as telecom).

– The partner shall support reporting and agreed review meetings with reasonable visibility on its activities and an adequate level of information.

– The review meetings shall be held in MTU AeroEngines facility.

General Requirements:

– The partner shall work to a certified standard process.

Task 2: Analysis

– The partner shall study and evaluate the given requirements for the future SLM/DMLS-machine, benchmark the technical choices and select the adequate technology in order to fulfil the given requirements.

– The partner shall demonstrate in a first phase which is the better and most suitable approach, giving a solid guideline, to develop the future SLM/DMLS machine with the given requirements.

Task 3: Development

– The partner shall construct a prototype of a SLM/MLS machine which fulfils all mentioned requirements.

Task 4: Validation

– The partner shall perform the necessary testing for prototype validation and optimization.

– The partner shall demonstrate the fulfilment of all requirements.

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

The applicant has to be a producer of SLM/DMLS-machines, who will develop the above mentioned techniques and implement them in commercial available machines.

Thus the applicant should have:

– At least several years experience in the development and production of SLM/DMLS systems

– Experience in the aerospace market, ideally with SLM/DMLS systems already producing aero engine components for some years at companies within the aerospace industry

– ISO 9001 certification covering the development, production and service of SLM/DMLS systems

– Sufficient R&D resources and competence to enable the development of the deliverables, including mechanics, optics, software, materials and process development

– Capability to ensure reliable availability of production machinery following success of the development project, including sales and service organization in all relevant regions worldwide, adequate financial resources, and necessary IP rights

– Ideally existing experience in at least some of the project topics, e.g. SLM/DMLS of non-weldable superalloys, integrated process and quality control systems, etc.

– Ideally experience in collaborative R&D projects in the field of SLM/DMLS

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Detailed Project Plan	schedule with milestones, technical specification of process and equipment	T0 + 1M
D2	Prototype Hardware	H/W produced by a SLM/DMLS equipment which fulfils at least the first two requirements	T0 + 22M
D3	Optimized Prototype Hardware	H/W produced with optimized SLM/DMLS process and equipment (conformance to all requirements)	T0 + 36M

4. Topic value (€)

1,800,000 €
[one million eight hundred 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

The proposal of the applicant has to include maximal realizable values for every given requirement.

A detailed work plan and time schedule is being expected. A profound financial plan must be attached as well. The applicant must fulfil the above mentioned requirements.

Topic Description

CfP topic number	Title		
JTI-CS-2010-04-SAGE-04-007	**Development of Selective Laser Melting (SLM) Simulation tool for Aero Engine applications**	**Start date**	*T0*
		End date	*T0 + 36M*

1. Topic Description

A first generation of geared turbofan engine (GTF) technology has found its way into the regional and narrow body market due to significant reductions in fuel consumption and noise compared to conventional turbo fan engines.

The purpose of the advanced GTF demonstrator as part of the Sustainable and Green Engine (SAGE) platform is to further advance these technologies and to achieve a next step change in fuel burn reduction combined with an additional decrease in noise emission. Components and modules with new technologies are to be developed, implemented and validated through rig testing as required before integration into a donor engine and SAGE4 full engine demonstration. The successful validation of technologies for this aircraft engine concept will then facilitate the early introduction of innovative new products into the market, and significantly reduce the environmental impact of air transport.

In order to answer the needs of the SAGE4 geared turbofan in terms of research, technological development and demonstration activities, it is planned to offer individual tasks to the industry, universities or any legal entity. Therefore, the present Call for Proposal supports the further development of manufacturing methods with a high optimization potential to allow alternative designs of environment-friendly aero-engine components, fabricated by means of metal based additive layer manufacturing (ALM) processes.

The current Call for Proposal is requesting to generate and validate a software tool to predict key properties of engine parts produced by SLM using essential material and process parameters. The intent is to create independent software modules for material and manufacturing process parameters feeding the structural model of the relevant engine part. The envisaged tool should provide a clear relationship between the loading pattern and manufacturing optimized design of the engine part. To validate the functionality of the tool using a representative engine part that is being cleared for testing in the GTF Demonstrator vehicle is the aim of the activity to be launched by this call.

MERLIN, another substantial Level-1 FP7 project (TRL levels 3 – 4) addresses complementarily to this CfP topic activity, that provide a relationship between residual stress and distortion as a function of various process parameters for Additive Manufacturing and intends to use existing software tools without specific modelling.

Selective Laser Melting (SLM) and Electron Beam Melting (EBM) represent ALM technologies which are applied in order to build metal objects layer by layer from 3D model data. These processes offer the possibility to change a manufacturing driven design to a design driven manufacturing and therefore realize ideally shaped parts optimized in weight and function. Thus, current production technologies for aero engine components, e. g. grinding and casting, can be completed or replaced by a group of technologies that is able to build high quality parts in a very resource respectively cost efficient way. However, SLM and EBM still have some deficiencies due to the manufacturing process. Currently, the development of new materials and applications with optimum quality and material characteristics is an iterative procedure and thus, extremely cost intensive.

Hence, the overall objective of this project is to develop an integrated simulation model that is able to determine material dependent process parameters for the manufacture of aerospace parts for the GTF. The quality targets comprise high density, reduced distortion and residual stresses as well as specified microstructure characteristics. This simulation would end in a significant decrease of costs and therefore would bring this technology a large step forward.

Based on the given target, the partners work includes the following tasks:

Task 1: Management

Organisation:

– The partner shall nominate a team dedicated to the project and should inform MTU AeroEngines project manager about the name/names of this key staff. At least the responsibility of the following functions shall be clearly addressed: Program (single point contact with MTU AeroEngine), Technics & Quality.

Time Schedule & Workpackage Description:

– The partner is working to the agreed time-schedule & workpackage description.

– Both, the time-schedule and the workpackage description laid out in this Call shall be further detailed as required and agreed at the beginning of the project.

Progress Reporting & Reviews:

– Quarterly progress reports in writing shall be provided by the partner, referring to all agreed workpackages, technical achievement, time schedule, potential risks and proposal for risk mitigation.

– Regular coordination meetings shall be installed (preferred as telecon).

– The partner shall support reporting and agreed review meetings with reasonable visibility on its activities and an adequate level of information.

– The review meetings shall be held in MTU AeroEngines facility.

General Requirements:

– The partner shall work to a certified standard process.

All of the following tasks consist of 5 phases:

1 Analysis

2 Development

3 Application

4 Validation

5 Optimization

Task 2: Structural model

The objective of this task is to develop a thermo-mechanical structural model that shall serve as the central component of the simulation tool which is used as the human software interface. Thus, the structural model must be suited to deliver process parameters for the manufacture of different materials (e. g. nickel based super alloy or titanium alloy). With the structural model, the transient behaviour of temperatures, distortion and residual stresses must be calculated on the basis of single layers as well as for the complete engine part independently from the required alloy. Hence, the structural model must return optimized process parameters in terms of beam power, scan strategy, layer thickness, part support and orientation. The structural model must have interfaces to both focal points, process module as well as material module. A further interface to the manufacturing systems' control units is necessary in order to realize a process related simulation.

Task 3: Material module and process module

Within this task, adequate software interfaces between the structural model (cf. task 2) and both the material and process module must be developed in order to examine relevant effects on an industrially useable detail level. Hence, the current state inside the process zone in terms of material behaviour and process conditions can be used for the integrated simulation tool (cf. task 3) based on the structural model.

First, the process model will represent the most relevant physical effects during beam-material interactions such as energy absorption and heat source distribution respectively the heat affected zone. Second, the material model shall provide information about the resulting microstructure characteristics such as grain size distribution and material properties (e. g. metallurgical phases, carbides) based on the given transient temperature field. However, as the integrated simulation model shall be used for application-relevant demonstrator parts, the knowledge of the specific material properties and models is a critical aspect. Therefore, the aforementioned material and process modules must be fully validated by measured values of the applied nickel based super alloy as well as with given titanium alloy.

Task 4: Integrated simulation model

The basic structural model together with the process and material module must be integrated into a global simulation tool. Thus, interfaces between the detailed analysis in terms of process and material on the one hand as well as the structural model on the other hand must be developed. Finally, the integrated model shall enable the simulation of complete parts from nickel based super alloys as well as from a titanium alloy with the target variables temperature field, distortion, residual stress, crack formation, material density and microstructure properties.

Task 5: Validation, optimization and implementation

The integrated model can only be successfully applied in terms of the additive layer manufacturing of optimized parts, when the calculated results have been validated and thus, the simulation has proven to concur with experimental results from SLM and EBM machines. Therefore, a two-stage approach shall be chosen. First, the build up of test geometries must accompany the development of the structural model as well as the material and process module. Second, after the integration of the above mentioned three partial models application-oriented aero engines parts must be manufactured by SLM / EBM in order to evaluate the correct prediction of process parameters by the developed simulation tool.

As a further step, an optimization algorithm shall be developed and associated with the global simulation tool. This function constitutes a crucial step towards the industrial utilization of the simulation model and must provide the software user with automatically generated optimum solutions in terms of the necessary process parameter settings.

As a last step, the complete calculation tool as described above has to be implemented in the software architecture of MTU Aero Engines GmbH. Therefore, a cooperation with the relevant departments is necessary.

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

Ability to model and simulate the behaviour of melting and cooling of metals by providing multiple years of experience in usage of multiphysics simulation environments (e.g. ANSYS)

General materials knowledge in terms of aerospace relevant manufacturing processes (e.g. friction welding, friction stir welding, grinding, laser welding, electron beam welding).

Specific knowledge in alloys relevant to aerospace applications (e.g. aluminium, titanium, nickel based alloys).

Profound knowledge of technical requirements in terms of aero engines components (e.g. strength, surface and microstructure quality).

Intensive knowledge in the development of simulation approaches for manufacturing processes, including structural, process and material aspects

In-house validation of the simulation results in terms of manufacturing with different laser and electron beam ALM equipment.

Measurement of residual stresses, e.g. by means of neutron diffractometry (i.e. Stress-Spec).

In-house measurement techniques (i.e. thermograph) to use for process observation.

Background knowledge in the development, optimization and application of ALM systems

Specific knowledge based / cognitive systems (e.g. machine learning frameworks) for simulation related optimization algorithms

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Detailed Project Plan	schedule with milestones, technical specification of simulation process	T0 + 1M
D2	Structural model	Simulation model which provides information about the geometry distortion and residual stresses due to manufacturing	T0 + 12 M
D3	Process and material module	a) Interfaces to and basic representation of the process and material behaviour during beam impact on a more detailed basis.b) Interfaces to the manufacturing systems' control units	T0 + 18M
D4	Validation of D2 and D3	a) Comprehensive material measurements of nickel based super alloys and titanium alloy and b) Concurrent SLM / EBM experiments	T0 + 24M
D5	Integrated simulation model	Simulation model that considers part geometry and can be used to calculate target variables e. g. distortion, residual stress, crack formation, material density	T0 + 30M
D6	Optimization algorithm and implementation	a) An optimization algorithm to achieve adequate parameters for high process stability and an acceptable part quality has successfully been applied and the complete tool is integrated into the MTU software environment. b) Options for the diagnosis of the integrated simulation system are implemented.	T0 + 36M
D7	Final Validation	Validation of the entire simulation model with a real engine demonstrator part which is to be defined during the project	T0 + 36M

4. Topic value (€)

1,000,000 €
[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

A detailed work plan and time schedule is being expected. A profound financial plan must be attached as well. The applicant must fulfil the above mentioned requirements.

Clean Sky - Smart Fixed Wing Aircraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	**8**	**3.999.000**	**2.999.250**
JTI-CS-SFWA-01	*Area01 – Smart Wing Technology*		**1.842.000**	
JTI-CS-2010-5-SFWA-01-007	In field surface inspection tool for contamination detection before bonded composite repair		250.000	
JTI-CS-2010-5-SFWA-01-014	Final design and manufacturing of a test set up for the investigation of gust load alleviation		400.000	
JTI-CS-2010-5-SFWA-01-030	Quantification of the degradation of microstructured coatings		200.000	
JTI-CS-2010-5-SFWA-01-031	Assessment of the interaction of a passive and an active load alleviation scheme for a transport aircraft		200.000	
JTI-CS-2010-5-SFWA-01-032	Technology evaluation and manufacturing of microtechnology-based Active Flow Control actuators		300.000	
JTI-CS-2010-5-SFWA-01-033	Numerical Simulation of the Assembly Tolerances for NLF Wings		492.000	
JTI-CS-SFWA-02	*Area02 – New Configuration*			
JTI-CS-SFWA-03	*Area03 – Flight Demonstrators*		**2.157.000**	
JTI-CS-2010-5-SFWA-03-004	A340 Outer Wing Metrology		1.457.000	
JTI-CS-2010-5-SFWA-03-005	Surface quality measurement in flight		700.000	

Topic Description Sheet

CfP Topic Nr.	Title		
JTI-CS-2010-05-SFWA-01-007	In field surface inspection tool for contamination detection	Start Date	01/05/2011
		End Date	31/12/2012

1. CfP Topic Description

In bonded repair, high requirements exist for the quality (cleanliness) of the substrate surfaces in order to achieve high adhesive bond strengths. Detecting 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.

This CfP topic 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 that are already studied by the CleanSky members, the preferred method(s) to be investigated shall be based on mass spectrometry and/or gas phase sensors (like electrical noses).

The applicant has to investigate if relevant contaminants can be detected and quantified by these techniques. In particular it needs to be studied how such a technique can support the certification of bonded repair aircraft composite structures.

After testing and calibration of a laboratory set up, the construction, assembly and testing of a prototype surface inspection tool shall be done suitable for bonded repair.

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

- Knowledge in the field of surface/material analysis (mass spectrometry and/or gas phase sensors preferred)
- 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
D1.1.3-06-01	Testing of measuring principle	Explanation and testing of detection method in order to detect critical contaminations on CFRP; Documentation	**T+9M**
D1.1.3-06-02	Development of a measuring device for contamination detection	Development of an measuring device suitable for repair application in a repair shop environment; presentation of the design in a design review meeting with SFWA partners	**T+12M**
D1.1.3-06-03	Calibration	Calibration of measuring device including documentation (Report)	**T+16M**
D1.1.3-06-04	Testing of measuring device and final report	Testing of measuring device under repair conditions and final report	**T+20M**

5. Value of CfP workpackage

The total value of the proposal shall not exceed

€ 250.000,--
[Two hundred and fifty thousand euro]

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

6. Remarks

The expected starting date of the work is 05/2011; the location for testing the measuring prototype will be in Bremen.

Topic Description Sheet

CfP Topic Nr.	Title		
JTI-CS-2010-05-SFWA-01-014	Design and manufacture of wind tunnel test hardware	Start Date	01/04/2011
		End Date	30/06/2012

1. CfP Topic Description

Background :

For transport type aircraft, gust loads are most critical for the wing's strength design and structural fatigue. For investigating novel control approaches to gust load alleviation, Wind Tunnel Tests on selected technologies will be conducted on a model demonstrator. The hardware for these tests has to be designed and manufactured.

Scope of work :

The subject of this Call for Proposal topic is the design and manufacture of the device for simulating gust loads, the gust load generator, and of the 2D wing model section for use in ONERA's Meudon Center's S3Ch transonic wind tunnel.

This CfP is composed of two main hardware items (compare below figure) :

1. Gust generator for the wind tunnel: Finalisation of the preliminary design and manufacture of the hardware
   A preliminary design of the generator has been defined and is made of movable two 2D wings (profile sections) fixed on the walls of the wind tunnel. The developed concept has been tuned for generating specific gust characteristics as gust amplitude, frequency bandwith, etc. For pitch variation of the 2D profile sections an existing hydraulic system will be used.
2. The second item of this CfP is the finalisation of the design and the manufacturing of a 2D wing model equipped with a movable trailing edge control surface and embedded instrumentation. The model is mounted in a mechanical frame fixed on both wind tunnel walls allowing heave and pitch motions.

Note that both devices need to allow remote actuation and control.

The wind tunnel cross section dimension is about 0.8 x 0.8 m.

It is expected that the gust generator and the wing model are manufactured using metal and composite technologies. Pre-design data will be provided to the applicant by the SFWA partners.

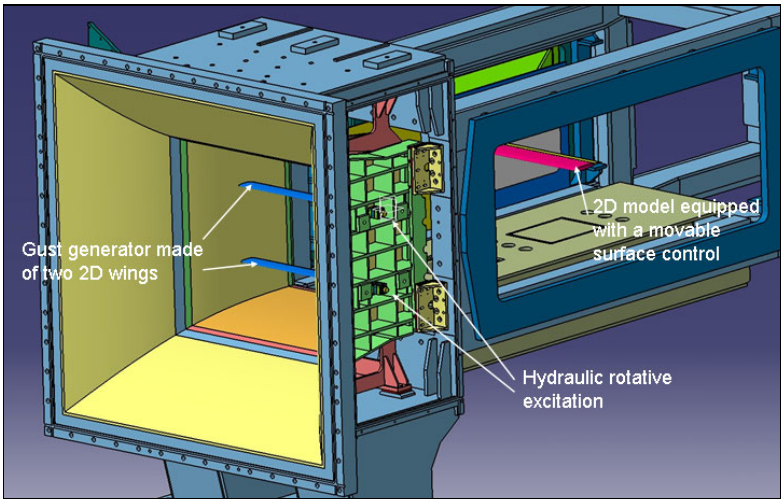


Figure 1 – Preliminary design of the WT set-up

Description of work :

Item 1 **: Design and manufacturing of the gust generator**

- Finalisation of the gust generator design.in metallic/composite structure, contribution to gust generator definition is required.
- Production of CAD drawing files
- Manufacturing of the gust generator
- Metrological control of each part and check for conformity with the CAD requirements
- Validation of the mechanical behaviour of the generator (operating tests)
- Assistance in mounting of the gust generator during qualification in laboratory conditions.

Input to Task 1 available from SFWA partners:

- Gust generator pre-design and associated CAD files
- CAD files of the WT environment

Item 2 **: Design and manufacturing of the model and mounting system**

- Finalisation of the model design. The applicant should
  - contribute to the model definition (general model architecture, optimisation of the assembly of composite/metallic structure).
  - contribute to the surface control actuating device. The applicant should propose an actuating means (actuator, electronic command and integration to the model) able to fulfil the specific characteristics (mechanical strengths, actuating dynamic performance and precision, working and security).
  - consider the integration of sensors and associated wires and tubes paths through the model (at least accelerometers, steady & unsteady pressure sensors; purchasing of this hardware is not included in this CfP).
  - Investigate future requirements which could include mounting a movable horizontal tail plane. The applicant should investigate the definition of this HTP and its integration on the model. The manufacturing of this hardware is not part of this CfP.
- Production of final CAD drawing files for the manufacturing
- Manufacturing of the model and the mounting system
- Metrological control of each part and check for conformity with the CAD requirements
- Proof of the correct functioning of the wing including its mounting device
- Assistance to the mounting of the gust generator during qualification in laboratory conditions

Input to Task 2 available from SFWA partners:

- Model and the mounting system pre-designs and associated CAD files
- CAD files of the WT environment

For both parts (gust generator and model), work progress needs to be presented in a final design review and a delivery review according to chart presented in the figure below. Moreover, there will be recurrent interactions between the applicant and SFWA partners during the tasks duration.

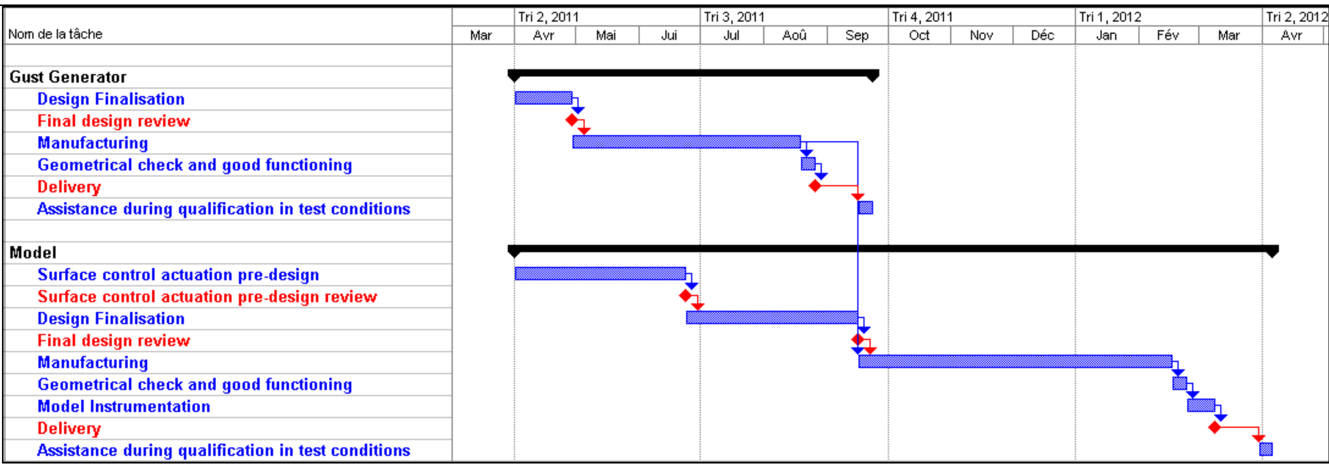


Figure - Gantt Chart / WBS

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

- The applicant shall have an industrial background in the conception and the manufacturing of wind tunnel models (high quality of aerodynamic surfaces)
- The applicant shall have skills in the manufacturing of metallic and composite structures
- The applicant shall dispose of the CAD software CATIA V5® (or a compatible software) to ensure the exchanges with the SFWA partners (inputs and deliverables)

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) + Report including: design validation, metrological control results and final CAD files	**T0 + 5 months**
D1.2.4-01-02	Model delivery	Delivery of the WT model parts (wing and mounting system) + Report including: design validation, metrological control results and final CAD files	**T0 + 12 months**

T0 = Date of signature by the partner

4. Value of CfP 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. Estimated spend profile [KEuro]

2009	2010	2011	2012	2013	2014	2015
0	0	300	100	0	0	0

6. Remarks

Topic Description Sheet

CfP Topic Nr.	Title		
JTI-CS-2010-05-SFWA-01-030	Quantification of the degradation of microstructured coatings	Start Date	01.03.2011
		End Date	01.03.2013

1. CfP Topic Description

The subject of this CfP topic is the quantification of the degradation microstructured coatings suffer while in service, during laboratory tests and after application in the paint shop. The degradation has to be determined using a geometrical analysis method focussing the analysis on the tip radius and the height of the structure. The structure will have a radius of less than 1 µm and a height less than 100 µm and will be provided by Fraunhofer IFAM.

For laboratory application a measurement method has to be chosen by the applicant producing good accuracy and reproducible results. The results shall be presented in bar charts demonstrating the distribution of the tip radii / heights of the measured structures.

In addition, a concept for a "quasi-realtime"-measurement shall be developed by the applicant in which the surface is at least partially measured in order to achieve representative information about its quality.

The work to be performed by the applicant includes:

- Choice of the suitable sensor and development of the measuring system.
- Get the go-ahead for manufacturing in a design review meeting.
- Final design and manufacture of the prototype measuring system for flat topographies.
- Accuracy evaluation and comparison of the novel measurement approach with laboratory methods.
- Investigation of the vibration during measurement and its influence on measurement results.
- Demonstration of the measurement system.
- Optimization in terms of accuracy and measurement speed after system acceptance review.
- Documentation.

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

- The applicant has to have a sound background in optical measurement methods.
- The applicant has to have a laboratory with a wide range of microscopes.
- The applicant has to have high skills in measurement methods for topography recording.
- The applicant has to have experience with the use and accuracy of sensors and programming skills for software filters.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D1.1.3-?-01	Report on the Progress of quantification degradation in laboratory	The analysis of the degradation of the microstructured coating is started and first results available	**01.05.2011**
D1.1.3-?-02	Suitable sensor for "quasi-real-time" measurement selected	Choice of suitable sensor for "quasi-real-time" measurement	**01.06.2011**
D1.1.3-?-03	Prototype developed	Development of the prototype and accuracy evaluation	**01.01.2012**
D1.1.3-?-04	Quantification of the degradation in a laboratory environment finished	The analysis of the degradation of the microstructured coating is finished	**01.02.2012**
D1.1.3-?-05	Report on the investigation of vibration effects	Investigations of vibrations of the measurement system	**01.10.2012**
D1.1.3-?-06	Optimization of the system completed	Optimization in terms of accuracy and measurement speed	**01.02.2013**
D1.1.3-?-07	Documentation	Report	**01.03.2013**

4. Value of CfP workpackage

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

€ 200.000,--
[Two hundred thousand euro]

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

5. Estimated spend profile [Euro]

2009	2010	2011	2012	2013	2014	2015
0	0	70	100	30	0	0

6. Remarks

None

Clean Sky Joint Undertaking
JTI-CS-2010-5-SFWA-01-031

Topic Description

CfP Topic Nr.	Title		
JTI-CS-2010-05-SFWA-01-031	Assessment of the interaction of a passive and an active load alleviation scheme for a transport aircraft	Start Date	01.01.2011
		End Date	30.06.2012

1. Topic Description

Load alleviation is a current research topic for the reduction of airloads. While modern aircraft already employ some load alleviation functionalities, innovative approaches both for passive and active solutions are under investigation, aiming at the so-called adaptive wing which provides optimal performance over a wide operational range.

Both passive and active load reduction, technical solutions have been proposed by SFWA partners. To take full advantage of a load control scheme, either passive or active, the wing structure has to be designed and optimized accordingly. This might lead to the fact that later retrofit solutions will not lead to the desired results, or that passive and active load reduction schemes might even be detrimental to each other. This interaction shall be investigated in this call for proposal.

In this Call for Proposal, engineering support is requested for the investigation of the interaction of a passive and an active load alleviation scheme for a relevant transport aircraft model. The basic aircraft data as well as the specification of the load alleviation schemes will be provided.

In detail the requested support and development tasks are:

- Set-up of reference aircraft model; components are provided by SFWA partners
- Set-up of analysis models, integrating passive and active load control schemes; data of the technical approaches are provided by SFWA partners
- Definition of evaluation scenarios for gust load alleviation and / or manoeuvre load alleviation; definition of open design parameters and evaluation criteria
- Analysis of performance of passive and active load control schemes, single and in interaction, by simulation
- Investigation of the variation of structural design parameters on the passive and active load control performance
- Discussion of results and delivery of documentation to involved partners.

Regular technical and progress meetings with WP lead (location Germany) and WP partners, as well as the participation at all technical WP 1.2.2 meetings, are expected.

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

- The applicant is required to provide in-depth experience in the following fields:
  - structural dynamics;
  - aeroelastic and aeroservoelastic modelling;
  - aeroelastic and aeroservoelastic analysis, both in the frequency and in the time domain.
- The applicant shall have experience in the use of commercial standard analysis tools for structural design, aeroelastic analysis and control layout (knowledge of NASTRAN and MATLAB/SIMULINK is mandatory).
- The applicant shall have experience in the use of large finite element models and typical control laws with industrial relevance.
- The applicant shall have experience in the analysis of load control applications with industrial partners.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.2.2.-xx-01	Technical Report: Description of Analysis Models	Description of reference model and models equipped with passive and active load alleviation	30.06.2011
D1.2.2.-xx-02	Technical Report: Definition of Test Scenarios	**Definition of test scenarios; definition of open design parameters and evaluation criteria**	31.09.2011
D1.2.2.-xx-03	Technical Report: Analysis Results	Evaluation and discussion of analysis results; discussion of trade-offs	31.05.2012
D1.2.2.-xx-04	Final Report	Final Report	30.06.2012

4. Topic value (€)

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 Clean Sky program.

5. Estimated spend profile [Euro]

2009	2010	2011	2012	2013	2014	2015
0	0	130	70	0	0	0

6. Remarks

Topic Description Sheet

CfP Topic Nr.	Title		
JTI-CS-2010-05-SFWA-01-032	Technology evaluation and manufacturing of microtechnology- based Active Flow Control actuators	Start Date	01.06.2011
		End Date	31.05.2012

1. CfP Topic Description

The subject of this Call for Proposal topic is the development of a manufacturing technique for fluidic active flow control (AFC) actuators based on micro technologies (µAFC) and the manufacturing of such kind of actuators. The actuator shall be a Zero Net Mass Flux actuator and shall be fabricated using MEMS fabrication technologies. Furthermore the manufactured prototypes shall be integrated into a mock-up for demonstration including driver electronics. Major components should be suitable to be integrated locally in the inside of the device structure. Integration issues of the actuator as well as the actuator electronics should be part of the concept and of the demonstrator.

The most important part of the actuator is the transducer, which converts electrical energy into mechanical work. For best performance of the actuator, different actuation principles (e.g. capacitive, electrodynamic) should be compared. The integration of active material into silicon based systems is a challenging approach but it is essential for the µAFC-Systems. Therefore, bonding technologies for piezoelectric transducers should be in the proposed solution as well. The to be delivered demonstrator should include a number of (preapproved) actuators and actuator driver electronics that is designed for the required voltages, the available voltages based on aircraft requirements and typical wind tunnel requirements as well as the required frequency range. The design of the controller should be done in a way, that the to be controlled actuator meets 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 with respect to aircraft level targets. Typical frequency ranges will be provided by the SFWA partners but will be in the range of ultrasound.

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 model within SFWA in order to proof the concept and its system performance. 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. Information on requirements for integration and certification will be provided by the WP and industrial partners. Results shall be analyzed, documented and optimized with regards to aero system requirements. A laboratory environment is considered as sufficient for functional hardware tests. The final experimental system ground test has to proof the system performance.

The description of the µAFC-System concept should reflect the technical data as well as other system and economic issues like operability, reliability, maintenance and costs. Finally, the obtained test results have to be exploited towards aircraft level integration. While this CfP topic will be managed within the frame of the SFWA work package on fluidic actuators, the aerodynamic requirements and the control algorithm will also be communicated together with the SFWA work package on flow control for low speed/ high lift and the work package on high speed flow control concepts.

The expected maximum length of the proposal is 20 pages

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

- The applicant has to have a calibrated laboratory environmental test unit
- The applicant should have a sound background in design and manufacturing of MEMS based microactuator and microsystems as well as control of actuators
- The applicant should have a sound research background and understanding of industry needs and expertise in silicon based MEMS.
- The applicant shall be able to manufacture mock-ups with respect to dimensions on aircraft level and principle demonstration of prototypes.
- The applicant shall provide support for integration and operation in super-coordinate tests.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D01	Pre-design analysis and concept Report	Description of conceptual design.	**01.07.2011**
D02	Component documents	Construction and manufacturing of mock-up of system needs allocated.	**01.08.2011**
D03	Manufacturing	All components available for integration.	**01.10.2011**
D04	**Testing**	Tests conducted with regards to design variations and system performances needs and pre-analysed.	15.12.2011
D05	**Technical report**	Final test data analysis and final reporting.	15.01.2012
D06	**Delivery prototype**	Design and manufacture of downsized principle prototype for ground tests. Delivery of prototype. Documentation.	01.02.2012
D07	**Final technical report**	Final test data analysis and final reporting.	15.05.2012

5. Value of CfP workpackage

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

€ 300.000,--
[Three hundred thousand euro]

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

6. Remarks

Possible background knowledge and intellectual properties will be handled by individual implementation agreement, if needed.

Topic Description Sheet

CfP Topic Nr.	Title		
JTI-CS-2010-05-SFWA-01-033	Numerical Simulation of the Assembly Tolerances for NLF Wings	Start Date	01.02.2011
		End Date	31.10.2012

1. CfP Topic Description

The design of an aircraft wing under natural-laminar-flow specifications (NLF), requires accurate and high precession tolerances for manufacturing, assembly processes and flight deformation. In the assembly process of SFWA (Smart Fixed Wing Aircraft) torsion box there are significant risks not to reach the expected tolerances. In the present CfP, it is proposed to minimize the mentioned risk in the torsion box assembly process by applying numerical simulation prediction previous to the assembly process. Optimum tolerances for assembly and fastening techniques will be determined. The models will be validated applying the proposed methodology using experimental setup including sensors and calibration tools.

Objectives

The main objective of this CfP topic is the development of a methodology (numerical approach by means of Finite Element Method) for the analysis of the assembly process considering the propagation/accumulation of deviations and the stresses/strains fields introduced on the components during the assembly process. The method should determine the influence of the assembly sequences and allow selecting the best assembly strategy. The methodology must be specifically defined to cover the tolerance range required by NLF.

The methodology will be applied for studying a real wing upper cover and its assembly in the following steps:

- Analyze possible deviations on the surface of this wing part as a consequence of the assembly process of the components. Check the fulfilment of the specified assembly tolerances.
- Study the influence of the fastening techniques (mainly due to rivets and/or bolts) on the assembly tolerances considering materials, sizes, forces/ torques, number of fasteners and distributions, clearances, etc.
- Evaluate the possible influence of deviations coming from the jig setup (including thermo-mechanical effects, jig deviations generated during the assembly, etc).
- Determine the best assembly strategy.

Numerical and statistical tools will be required for simulating the mechanical and geometrical aspects of the assembly processes (i.e. FE simulation tools). For validation purposes, experimental setup and tests such as assembly bench, high precision measurement devices, coordinates measurement machine, etc. are necessary to validate the numerical modelling.

Regarding the fastening technique and the number of fasteners essentially required, a specific task will be realized for their accurate modelling. The simulation models will investigate the behaviour of riveted/bolted joints covering aspects such as out-of-plane and in-plane stress/strain locally generated, clearances between bolt/rivets and holes, fastener flexibility and fastener clamp-up.

Work to be performed

The work plan has to cover the following aspects:

WP1: Influence of the fastening techniques on the tolerances of the assemblies, covering

- Characteristics of the joints (materials, forces/ torques, distributions, clearances, etc).
- Analysis of local stress/strains at the fixation points that, accumulated in the component, may generate global distortions.
- Modelling of joints rigidity that may affect the final geometry of the assembly. Task to be carried out preferably through the FEM as mechanical analysis tool.

WP2: Development of a strategy for assembly tolerances based on the results obtained from WP1.

WP3: Methodology for assembly tolerance analysis of complex aircraft parts, considering:

- Statistical data related to stack-up tolerance values of geometrical and dimensional deviations of the studies components.
- Effects of component compliancy on assembly tolerances. (FE numerical tools required).
- Influence of the joining technique.
- Influence of possible deviations coming from the jig setup (including thermo-mechanic effects, jig deviations generated during the assembly, etc).
- The assembly sequences influence, which may define different "ways of tolerance propagation".

WP4: Validation of the methodology through the analysis of a representative part. Experimental study of the assembly process (tolerances vs. assembly sequences) for a real part and application of the methodology previously developed for obtaining a correlation. This task will require the selection/definition of the part to be analyzed and the construction of a specific assembly bench to represent the counterpart in the assembly process. As was mentioned, this task will require also other means of experimental tools (i.e. assembly bench, high precision displacement sensors and positioners and coordinates measurement machine).

WP5: Evaluations and conclusions: Tolerance analyses of wing upper cover (real aircraft part), check the fulfilment of the specified assembly tolerances and selection of the best assembly strategy.

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

- The applicant should have experience in the numerical modelling of composite structures and assembly tools/jigs.
- The applicant should have experience in the numerical modelling of mechanical joints (riveted, bolted, adhesive, etc).
- The applicant shall own metrological means to carry out the validation of the methodology through the analysis of a real part within the required tolerances (for example a 3D coordinates measurement machine).
- The applicant should have experience in the integration of probabilistic and numerical tools, required for the tolerances analysis methodology to be developed.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D1.1.3-01-01	Joining techniques analysis	Joining techniques influence on the tolerances of assemblies considering the characteristics of the joints (materials, forces/ torques, distributions, clearances, etc), the local stress/strains generated at the fixation points and the joints rigidity. Details to be presented in a technical report	**30.09.2011**
D1.1.3-01-02	Computationally efficient simulation strategy	Computationally efficient techniques for the representation of the riveted/bolted joints. Details to be presented in a technical report	**28.02.2012**
D1.1.3-01-03	Methodology for assembly tolerances analysis	Development of a methodology for assembly tolerances analysis of complex aircraft parts, considering: - Statistic stack-up tolerances. - Parts compliancy on assembly tolerances. - Influence of the join technique. - Influence of possible deviations coming from the jig setup. - The assembly sequences. Details to be presented in a technical report	**31.12.2011**
D1.1.3-01-04	Validation of the methodology	Validation of the methodology through the analysis of a representative part (laboratory level). Details to be presented in a technical report	**30.04.2012**
D1.1.3-01-05	**Tolerance analysis of wing upper cover**	Analysis of a real part. Check the fulfilment of the specified assembly tolerances. Selection of the best assembly strategy. Details to be presented in a technical report	**31.10.2012**

4. Topic value

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

€ 492.000,--
[Four hundred and ninety two thousand euro]

Please note that VAT is not applicable in the frame of the *CleanSky* program
Representative part for validation not included.

5. Estimated spend profile

2009	2010	2011	2012	2013	2014	2015
0	0	292 kEuro	200 kEuro	0	0	0

6. Remarks

Final version

Project:	Clean Sky SFWA-ITD
Work Package:	SFWA 3.1
Topic Manager:	David Belfourd
Deputy Topic Manager:	Steve Williams
Date of issue:	10th August 2010

Call for Proposal Topic Description Sheet

CfP Topic Nr.	Title		
JTI-CS-2010-05-SFWA-03-004	Outer Wing Metrology	Start Date	01.02.2011
		End Date	30.06.2014

1. CfP Topic Description

Introduction

The objective of this CfP topic is to provide metrology solutions to the SFWA High Speed Demonstrator which is focused on Natural Laminar Flow demonstration. For the tests the outer sections of the wing will be replaced with sections suitable for laminar flow as shown in the sketch below.

Requirements

The ability to measure and control the surface quality during wing assembly and assembly to the flight test aircraft is a must to ensure the success of the project.

At this point SFWA will not release the specific details of the tolerances required to be measured in this experiment, and will be unable to do so until contract award owing to the proprietary nature of the data. In order for suitable candidates to proceed to bid with confidence the following guidelines are provided.

- Most measurements required to be taken are within the capabilities of commercially available instruments, some experience in the field of optical scanning methods are likely to be required
- Indications of the type, quantity and likely nature of the measurements are given in the measurement approach section.

Tasks

The measurement approach section describes the measurements that are required to be taken throughout the project, the overall objective is to record and understand the built condition of the wing as it progresses through manufacture and on to the wing and to be able to compare any of the measurements so that analysis can be performed to determine specific effects or causes of degradation of requirements.

Measurement Approach

- Profile - Laser tracker or similar device to achieve accuracy of 0.1mm to 3 sigma evaluated in Spatial Analyzer (according to Airbus Standard process CPR 1037).

Scan at each rib bay position forward to aft, 25 places, upper surface only

- Waviness - The measurement method recommended is white light fringe projection or laser scanning. The system should be evaluated/validated against VDI/VDE 2634 part 2 (or other suitable guideline or standard) to give an accuracy of 0.01mm at 2 sigma.

All visible areas of the wing for which a waviness tolerance has been defined should be measured. This will comprise a series of measurements assessing the waviness at key locations. For chord-wise waviness measurement, patches of no less than 400mm x 400mm are required. For span-wise waviness measurement, patches of no less than 1000mm x 1000mm are required or ‘stitching’ of adjacent patches of smaller size to give 1000mm x 1000mm tiles. Stitching accuracy to be no worse than 2 times the measurement accuracy for the system.

- Roughness – Talysurf or similar device

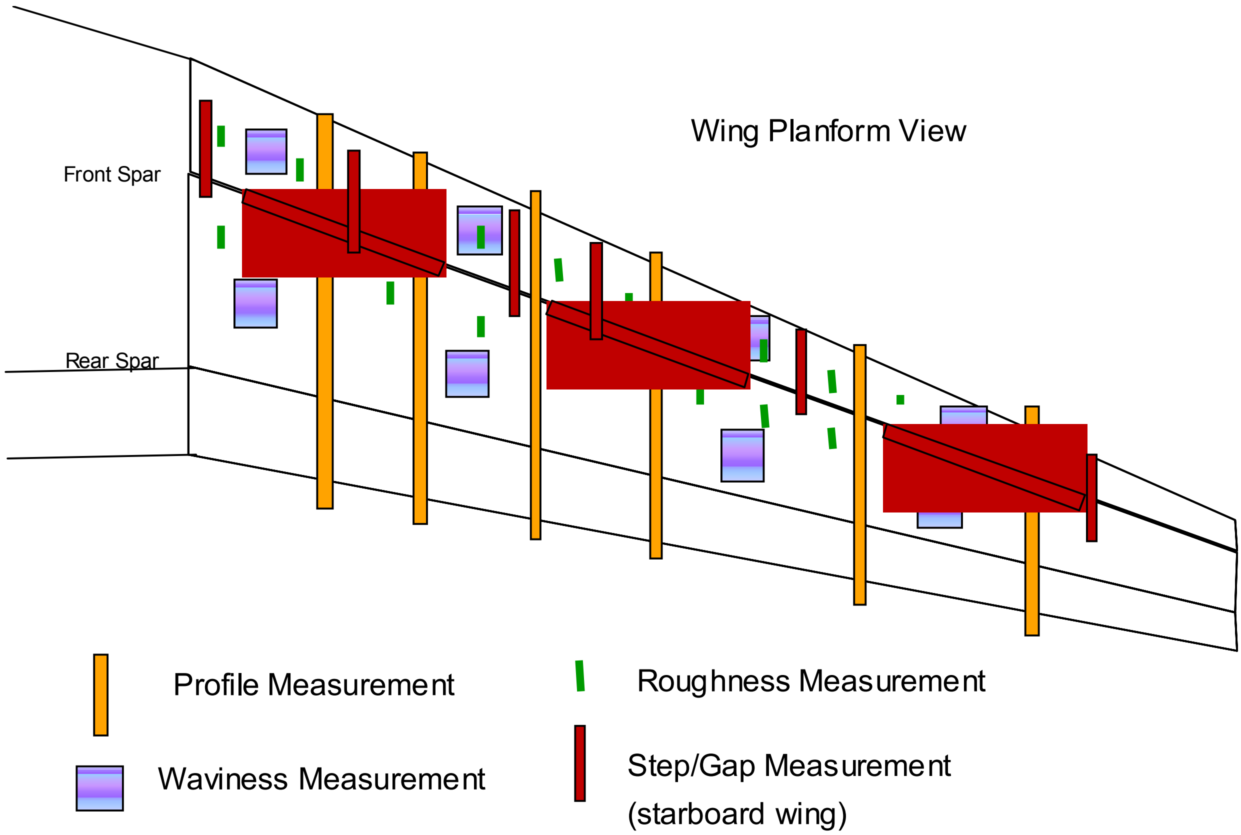
Measure at each rib bay position, 50 places = 25 on leading edge, 25 mid panel upper surface

- Step and gaps - Laser tracker or similar device to achieve required accuracy measurements will be taken along the leading edge chordwise and spanwise (starboard wing only)

Skin to leading edge (chordwise) measure at each rib bay position, 25 places.

Leading edge to leading edge (spanwise) measure 3 positions at each joint = 9 places

- The number of measurement points required and exact position is likely to develop as the programme moves forward. The details above are provided for estimating purposes at this stage. A fully detailed / dimensioned drawing will be produced to consolidate these requirements.



Typical measurements taken at various stages through the build

Schedule:

The activity would start in October 2011 to finish end 2013 with the end of flight tests.
Main events will be:

- Detail tooling & component measurements Saab, Linkopen, Sweden 2011
- Assembly tool measuring Vitoria, Spain, in 2011
- Outer Wing assembly Vitoria, Spain, in 2011
- Outer Wing intermediate assembly Vitoria, Spain, in 2012
- Outer Wing final assembly Vitoria, Spain, in 2012
- Outer Wing assembly out of jig Vitoria, Spain, in 2012
- Wing integration on the test aircraft in 2013
- Between Flight Tests #1 Toulouse, France in 2013
- Between Flight Tests #2 Toulouse, France in 2013
- Between Flight Tests #3 Toulouse, France in 2013

Number of measurements In accordance with the measurement plan, however adequate time will need to be provisioned in the submission for set up and site preparation at each of the locations. Please make clear your assumptions on the amount of onsite time that will be required for each event.

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

- Measurement of the waviness to the required accuracy is the biggest challenge and may require special equipment and techniques.
- The solution should be capable of scanning big surfaces as quickly and accurately as possible in order to minimise the impact of the measurements on the overall programme deliverables.
- Fully qualified operators and fully certified / traceable equipment to satisfy international standards for high precision, high volume measurements are essential to qualify the measurements taken

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date				
D3.1-11-01	Report on upper cover tooling – 2 off		Q3 2012				
D3.1-11-02	Report on Upper cover measurements – 2 off		Q3 2012				
D3.1-11-03	Report on assembly tooling – 2 off		Q3 2012				
D3.1-11-04	Report on upper cover in Main Assembly Jig – 2 off		Q4 2012				
D3.1-11-05	Report at intermediate assembly stage in jig – 2 off		Q4 2012				
D3.1-11-06	Report at final assembly stage in jig – 2 off		Q1 2013				
D3.1-11-07	Report at final assembly stage in jig, skin surface tools released – 2 off		Q1 2013				
D3.1-11-08	Report at wing removal – 2 off		Q1 2013				
D3.1-11-09	Report at wing join up to A340 wing – 2 off		Q4 2013				
D3.1-11-10	Report at point during flight test campaign – 2 off		Q2 2014				

4. Value of CfP workpackage

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

€ 1.457.000,--
[One million four hundred and fifty seven thousand euro]

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

5. Estimated spend profile

2009	2010	2011	2012	2013	2014	2015
0	0	268k€	700k€	489k€	0	0

6. Remarks

Topic Description Sheet

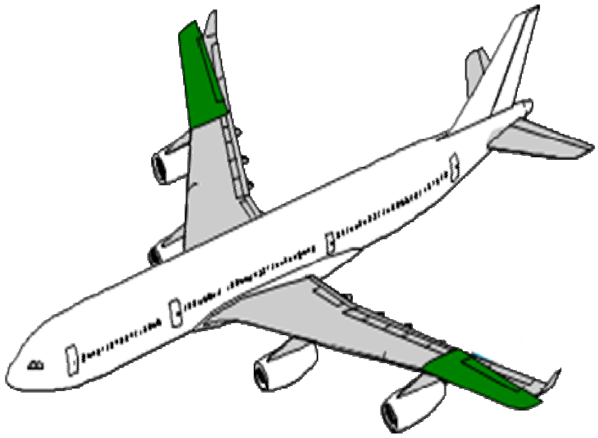
CfP Topic Nr.	Title		
JTI-CS-2010-05-SFWA-03-005	Local deformation measurements on the outer wing in flight	Start Date	01.01.2011
		End Date	31.06.2014

1. CfP Topic Description

INTRODUCTION

The objective of this CfP topic is to provide in flight wing local deformation measurement solution to the SFWA High Speed Demonstrator Passive which is focused on Natural Laminar Flow demonstration.

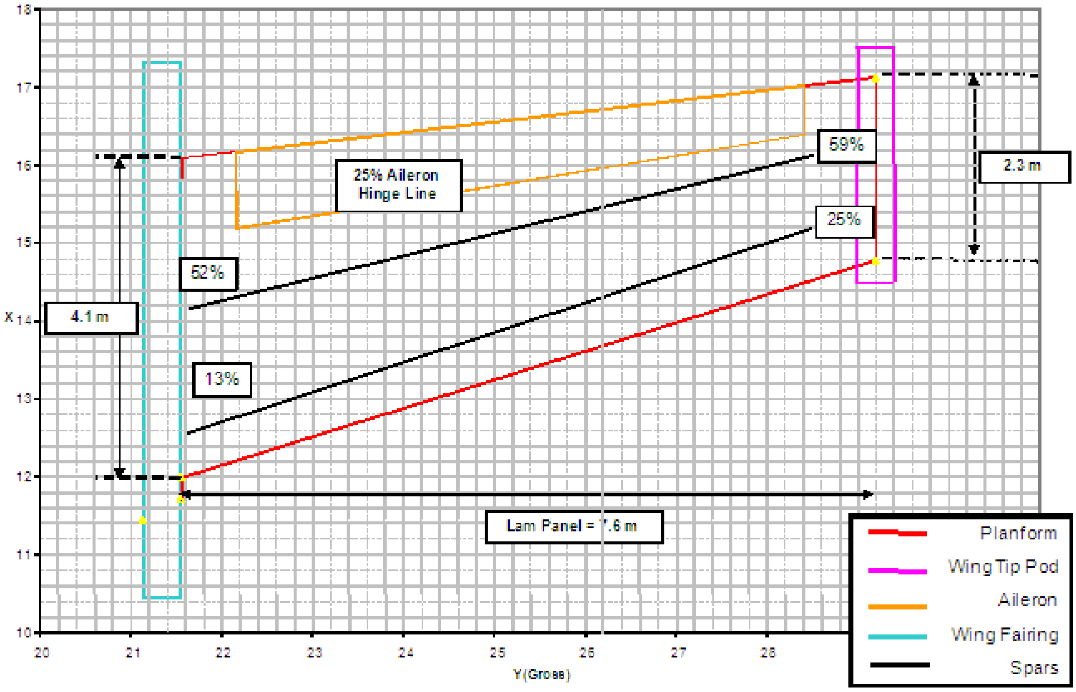
Selected planform is an A340-300 with the outer wing (two green areas in the following figure) will be replaced with new laminar wings.



Natural Laminar Flow is one of the key technologies to reduce aircraft drag and fuel consumption. However, its application on commercial aircraft requires manufacturing of a very high surface quality and a minimum of surface quality degradation during flight. Any defect (waviness, steps, gaps, insect debris...) could trigger the transition of the boundary layer to turbulent conditions thus cancelling the benefits of laminarity.

The task of the measuring device to be produced under this CfP topic is to detect any local deformation of the laminar wing surface in flight i.e. waviness, steps and gaps.

The laminar wing section is designed to allow a laminar flow area on the outer wing upper surface between the wing leading edge and the rear spar location. The figure below presents a 2D views of the laminar wing and provides information about its structure with in particular the location of the front and rear spars.



REQUIREMENTS

1. Measured area

The area of interest, regarding the local surface deformation measurement is limited to the upper wing surface included between leading edge and rear spar, with a **highest priority on the area located between wing leading edge and front spar.**

The measuring system shall be able to measure, on the upper wing surface, waviness and steps and gaps.

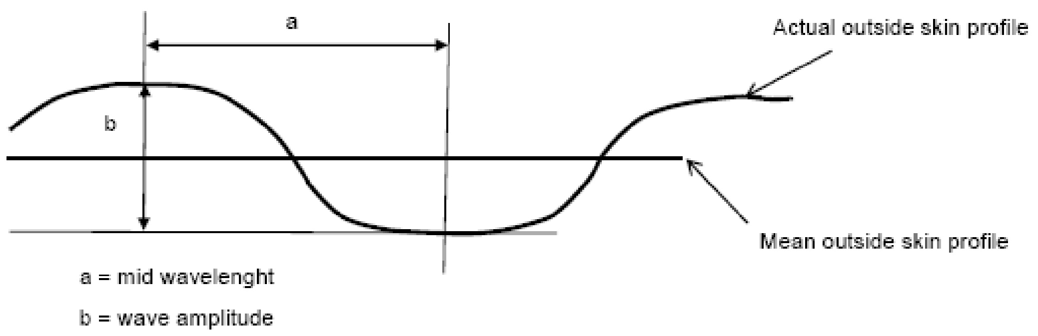
2. Accuracy

At this point Airbus will not release the full specific details of the tolerances required to be measured in this experiment, and will be unable to do so until contract award owing to the proprietary nature of the data.

In order for candidates to bid with confidence the following guidelines are provided :

- Considering the allowable surface deformation estimated, the measurement technique shall be able to characterize surface imperfections as small as :
  - Chordwise waviness (see definition of waviness characteristics on figure below) :
    b/a = 0.002 with typical values for a : 100 mm, 200 mm.
  - Steps & gaps (in line of flight or across LOF) of 0.1 mm on the full outer wing upper cover & leading edge.
- These deformations may make their accurate measurement very challenging to achieve. In any case, the expected accuracy shall be defined in the proposal. These specifications may be relaxed function of the proposed solution.
- The surface measurement technique shall be able to provide measured surface data in a patch of at leat 400 cm². The size of the measured area offered by the applicant will be part of selection criteria.

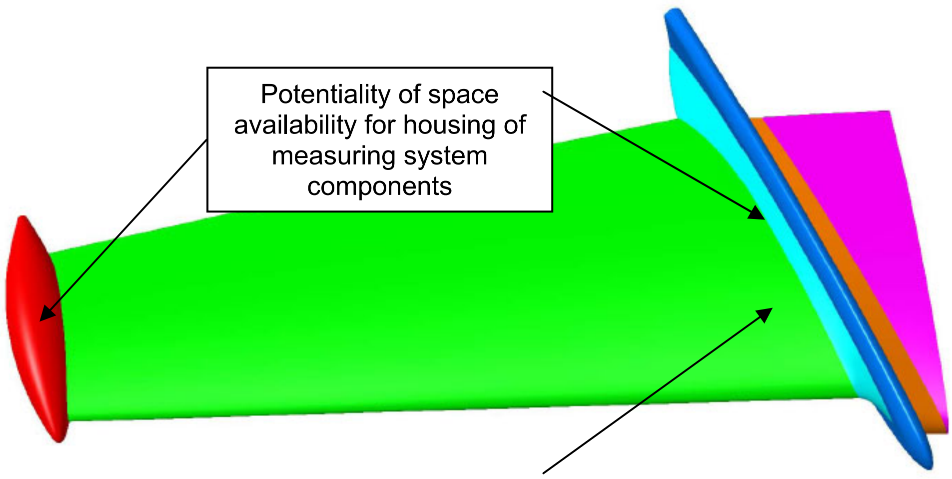
For the measurements, effects like density gradients in the flow may affect optical measurement techniques. Relevant information on the flow characteristics will be provided later by AIRBUS.



3. Installation

The measuring system may be installed in the wing inner or outer structure (see picture below). Note that a direct installation on the laminar wing is not allowed because of the risk of aerodynamic perturbations to the laminar flow.

Specific requirements for the installation of the measuring device such as special housing components can be consiederd as long as they are compatible with aerodynamic and structural integration constraints.



4. Operational conditions

The device shall sustain the following environmental conditio

Temperature: -55°C to +85°C
Pressure @ 41000 ft
The whole range of humidity and vibrations that could be encountered in flight will have also to be sustained by the measuring system (detailed information to be provided later by Airbus).

The device shall be able to be operated under the following typical flight test conditions :

Temperature: -55°C to +25°C
Pressure @ 41000 ft
Regarding humidity the device will be operated outside of clouds so a classic range of relative humidity has to be considered (range to be provided later by Airbus).
The measurement will be performed in stabilized flight test conditions, which will correspond to a low level of vibration (detailed information on the vibrations to be provided later by Airbus).

5. **Other constraints**

In case of a major impact on flight operations, the device shall be removable in a short period of time and without any further impact on the aircraft.
The measuring technique shall allow to assess the in flight wing deformation referenced to the shape on the ground.
The measurements will be performed in steady flight conditions (static measurement). No capabilities of real-time processing are needed (only differed time processing envisaged).
The data acquired have to be synchronised with the aircraft flight parameters.
The post flight download of the data recorded during flight has to be easy and quick.
The solution shall be capable to provide measurements with the requested accuracy on the biggest possible portion of the laminar wing upper surface (with priority on the area between leading edge and front spar).
The measuring device shall demonstrate a Technology Readiness Level of 5 at the end of 2011.

The **main selection criteria** are :

- Accuracy
- Area measured (size and flexibility)
- Installation constraints
- Techno maturity for in-flight application (TRL level and roadmap)

TASKS

The following tasks have to be performed :

- Definition and delivery of the measuring device architecture
- Design of the device and drawing delivery
- Manufacturing and delivery of the device and the associated documentation for installation
- The installation of device including the relevant equipment
- The operation of the device during the flight test campaign in Toulouse (to be confirmed)
- The data acquisition, processing, validation and delivery of results to the Airbus "Testing" WP leader

SCHEDULE:

The activity would start in January 2011 to finish end 2013 with the end of flight tests.

Main periods will be:

- Wing integration on the A340-300 MSN1 (Toulouse –France) : 6 months in 2013
- Flight Tests (Toulouse –France, to be confirmed): 6 months in 2013

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

- The measuring device shall demonstrate a Technology Readiness Level of 5 for the milestone corresponding to the Critical Design Review of the project (today envisaged end of 2011).

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D3.1-13-01	Architecture dossier and Drawings		**Q4 2011**
D3.1-13-02	Component delivery	Standalone measuring device ready for flight testing	**Q4 2012**
D3.1-13-03	Results	Report on the flight test campaign results and their validation	**Q4 2013**

4. Value of CfP workpackage

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

€ 700.000,--
[Seven hundred thousand euro]

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

5. Estimated spend profile

2009	2010	2011	2012	2013	2014	2015
0	0k€	170k€	250k€	280k€	0	0

6. Remarks

Clean Sky - Systems for Green Operations

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	**6**	**3.700.000**	**2.775.000**
JTI-CS-SGO-01	*Area-01 - Definition of Aircraft Solutions and explotation strategies*		**0**	
JTI-CS-SGO-02	*Area-02 - Management of Aircraft Energy*		**550.000**	
JTI-CS-2010-5-SGO-02-027	Simulation and Analysis Tool Development Part I		400.000	
JTI-CS-2010-5-SGO-02-031	Qualification of insulation materials to engine oils		150.000	
JTI-CS-SGO-03	*Area-03 - Management of Trajectory and Mission*		**1.150.000**	
JTI-CS-2010-5-SGO-03-011	Recruitment of qualified flight crew (test, airline) and expenses for tests		250.000	
JTI-CS-2010-5-SGO-03-012	SOG Wheel Actuator development for existing aircraft		650.000	
JTI-CS-2010-5-SGO-03-013	Economical analysis according to business jets operatorsprofile		250.000	
JTI-CS-SGO-04	*Area-04 - Aircraft Demonstrators*		**2.000.000**	
JTI-CS-2010-5-SGO-04-001	Design and manufacture of an aircraft tractor compliant with specifications for Smart Operations on ground		2.000.000	
JTI-CS-SGO-05	*Area-05 - Aircraft-level assessment and exploitation*		**0**	

Clean Sky Joint Undertaking
JTI-CS-2010-5-SGO-02-027

Topic description

CfP Nbr	Title		
JTI-CS-2010-5-SGO-02-027	Simulation and Analysis Tool Development	**End date**	01.05.2013
		Start date	01.03.2011

1. Background

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

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

2. Scope of work

The Modelica tool should be improved in the following regards:

1.) Convenient Direct Current (DC) and small signal analysis

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

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

2.) Multi-core simulation for power electronic circuits

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

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

3.) Convenient parameter studies

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

(a) Select one or more simulation results that shall be "kept" in the plot browser and select that one of the kept simulation results will always be used as reference in the plots (so if a variable is selected for plotting, then the same variable from the reference simulation should also be shown in the same figure). It should be possible to display in a convenient way the differences of parameter and initial values between the actual simulation run and of the reference simulation.

(b) During a simulation run, allow interactive changes of a Modelica parameter although the simulation is still running. Formally, such a change of a parameter is interpreted as stopping the simulation, changing the value of the parameter and restarting the simulation.

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

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

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

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

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

6.) Configurable automatic documentation of simulation runs

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

7.) Model layers

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

8.) Modelica model generation from CATIA Electrical Wiring Routing

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

3. Type of work

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

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

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

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Configurable post-processing features as needed for power electronic circuits (item 4)	Technical report and tool with this feature	31.03.2011
D2	Convenient DC and small signal analysis (item 1)	Technical report and tool with this feature	01.02.2012
D3	Model layers (item 7)	Technical report and tool with this feature	01.02.2012
D4	Multi-core simulation for power electronic circuits (item 2)	Technical report and tool with this feature	28.08.2012
D5	Convenient parameter studies (item 3)	Technical report and tool with this feature	31.11.2012
D6	Signal observers for requirements as needed for power electronic circuits (item 5)	Technical report and tool with this feature	02.01.2013
D7	Configurable automatic documentation of simulation runs (item 6)	Technical report and tool with this feature	02.01.2013
D8	Modelica model generation from CATIA Electrical Wiring Routing (item 8)	Technical report and tool with this feature	01.05.2013

6. Topic value (€)

The **maximum value** for this topic is

400,000 €
[four hundred thousand euro].

Please note any proposal above this value will be NOT be eligible.

7. Remarks

Only if applicable.

Clean Sky Joint Undertaking
JTI-CS-2010-5-SGO-02-031

Topic description

CfP Nbr	Title		
JTI-CS-2010-5–SGO-02-031	Qualification of insulation materials to engine oil.	**End date**	02/08/2012
		Start date	02/02/2011

1. Background

Insulation materials such as composites are used in the construction of electric generators. In addition to their dielectric characteristics, they also need high level thermal, mechanical and life properties due to the severe environment. More specifically, when they are used in oil-cooled on board generators, they have to withstand the aggressive synthetic engine oils. This resistance is difficult to anticipate due to the number of conditions of use such as material type and shape, manufacturing parameters, oil type, actual operating conditions. While oil manufacturers and composite materials manufacturers provide general information relative to chemical properties and resistance, they cannot provide enough valuable data on actual compatibility of materials in real conditions. Plastic materials used for sealing face a similar issue.

It would be therefore desirable to carry out an extensive test campaign on materials versus engine oils, covering various tests and aging conditions so as to quantify and analyse their oil resistance in real conditions. The test campaign should include the criteria for qualification of the materials.

2. Scope of work

The work shall cover 1/ methodology and definition of tests , 2/ carrying out the tests 3/ analysis of results and conclusion regarding qualification. The tests will be done on 3 (tbc) materials versus 3 (tbc) engine oils. Insulating materials will be tested as real manufactured parts (not only material sample). Test conditions shall include parameters such as temperature, stress, fatigue, aging. Tools may be required to do the tests in the required conditions (ex: real part under stress).

3. Type of work

Detailed definition of the test plan, with the aim of covering extensive combinations of materials, oils, test parameters. This definition phase will be a joint activity with THALES, particularly on the materials and oils to be tested. Definition of the acceptance criteria.

The materials and oils to be tested will provided by THALES.

Carrying out the tests as defined in the plan.

Analysis of the test results, report and conclusions on qualification.

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

Laboratory for material tests, in various environment conditions.

Expertise on composite and plastic materials.

Experience in aeronautics material tests, and qualification methodology.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Test plan	Detailed definition of the test plan of materials resistance to engine oils. Definition of the acceptance criteria.	02/05/2011
D2	Tests	Carrying out the tests as defined in the test plan.	02/05/2012
D3	Analysis.	Test analysis and conclusion on material qualification.	02/08/2012

6. Topic value (€)

The **maximum value** for this topic is

150,000 €
[one hundred fifty thousand euro].

Please note any proposal above this value will be NOT be eligible.

7. Remarks

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Topic description

CfP Nbr	Title		
JTI-CS-2010-5-SGO-03-011	Recruitment of qualified flight crews (test, airline) for simulator experiment (cycle 1) *Including preparation and analysis of the experiment from Flight Operations perspective.*	**End date** **Start date**	31-03-2012 01-06-2011

1. Background

The Systems for Green Operations ITD (Integrated Technology Demonstrator) of Clean Sky aims to demonstrate substantial environmental and economic benefits of new on-board systems and functions. Apart from the so-called "More Electric Aircraft" (MAE) those improvements will come from improved "Management of Trajectories and Missions" (MTM).

For the latter a Flight Management System (FMS) guidance function is being developed for Continuous Descent Operations (CDO), which is based on Time and Energy. The guidance logic takes multiple parameters into account and therefore we call this novel FMS function: Multi Parameter Guidance with Time and Energy Managed Operations (MPG-TEMO).

The innovation of MPG-TEMO, certainly with respect to current CDO's, is to allow idle-thrust descents when traffic density is high. Therefore MPG-TEMO will cater strict time constraints, thus bringing the environmental and economic benefits of CDO's to all-day operations.

This call for proposal is meant to involve flight crews with the development and validation of such a new guidance function. A flight simulator in the Netherlands will be used for those piloted validations.

2. Scope of work

The aim of this Call for Proposal is to select a partner who is able to bring the innovation of Continuous Descent Operations to the flight deck from the operator perspective. Therefore the partner is not just delivering flight crews for a simulator experiment, but is involved in the innovation of the MPG-TEMO in an interactive way with the current developers. The goal of this co-operation is to improve the maturity of this function from Technology Readiness Level (TRL 3) to TRL 4.

The work can be clarified in more detail:

a) Advice on improvements of the MPG-TEMO function from Flight Operations perspective. At the beginning of the work the results of a technical batch study are being analysed by the developer and demonstrations on a simulator mock-up can be provided. The technical batch study is to prove the maturity at TRL 3.

b) Development of Flight Procedures for Continuous Descent Operations with MPG-TEMO. As MPG-TEMO is expected to be introduced from 2018 onward, other novel functions are expected to be in place as well. Herewith roles of the Air Traffic Controller and the flight crew will change. The Airborne Separation Assistance System (ASAS) Interval Management is one of the functions that MPG-TEMO will work with. Sequence and content of the check-lists are seen as part of this activity.

c) Definition and selection of scenarios for the simulator experiment. Critical situations for the MPG-TEMO functions from the Flight Operations point of view are of interest. On the other hand the scenarios must represent realistic situations for the flight crews, participating in the experiment. Pilot questionnaires are to be delivered in relation to the scenarios.

d) Develop a Pilot Briefing Guide. With modern media an introduction guide will be developed that explains to the subject pilots the background of MPG-TEMO, how to operate with it and all other relevant information to take part in the simulator experiment.

e) Recruitment of qualified flight crews. Select and schedule flight crews for the simulator experiment. All costs related to the participating flight crews must be included in the bid. The experiment will be set up for 10 crews, each crew participating for 2 days at the simulator. It is assumed that a partners staff-member is present at the simulator on all experiment days. E.g. for additional explications to the flight crews and to collect all relevant data and notes required for the analysis.

f) Analysis. The participating pilots will file comments by questionnaires per simulated scenario flight as well as an overall questionnaire and through a debriefing. The partner will analyse all the comments to derive a general conclusion and recommendations for improvements on the MPG-TEMO function. The partner is responsible for the Analysis from Flight Operations perspective in close co-operation with MPG-TEMO developers' team that will perform the Technical Analysis.

3. Type of work

The type of work requested in this call for proposal is to develop new flight operations for 2018 and beyond, especially related to Continuous Descent Operations (CDO).

Additional the type of work is to validate by means of a flight simulator experiment an innovative FMS guidance technique for CDO, called MPG-TEMO that is based on the management of time and energy simultaneously. Apart from the validation experiment also work is requested in the preparations of the experiment (scenario's, pilot briefing guide, questionnaires) as well as in the analysis of it. This all from the flight operations perspective.

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

The candidate partner, which may be a consortium, must be able to deliver a "project pilot" and flight crews.

The "project pilot" (the person responsible for the work) has a long experience in flying commercial aeroplanes, and may be retired from active flying. Furthermore he has a technical background preferable in the field of air navigation and FMS functions.

For the flight-crews taking part in the simulator experiment it is required that they are actively flying commercial aeroplanes. The experiment improves in statistical relevance when the flight crews have different experience in both, number of flight hours as well as in type of aircraft. Though the simulator will comply with an Airbus A320 type of aircraft, it is expected that the flight crews can familiarise themselves in about an hour as situations which require the specific type-rating will not occur in the simulator experiment.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Flight scenarios to validate MPG-TEMO in a simulator experiment.	Based on the batch study results and mock-up demonstrations	15-08-2011
D2	Pilot briefing guide to participate in the MPG-TEMO simulator experiment.	Includes Flight procedures	15-10-2011
D3	Flight Operations Analysis of the MPG-TEMO experiment.	.	15-03-2012

6. Topic value (€)

The **maximum value** for this topic is

250.000 €

[two hundred fifity thousand euro]

Please note any proposal above this value will be NOT be eligible.

7. Remarks

The bid must include all travel costs to the Netherlands.

Clean Sky Joint Undertaking
JTI-CS-2010-5-SGO-03-012

Topic description

CfP Nbr	Title		
JTI-CS-2010-5-SGO-03-012	Smart Operation on Ground Wheel Actuator development for existing aircraft	**End date**	**September 2012**
		Start date	**March 2011**

Special Clause

The text of this topic contains the basic information for the applicant to understand the need of the ITD Topic manager.
However, more detailed data are available in a separate document that can be provided on request to the interested applicant; due to the confidentiality content of this supplementary document, it is necessary to enter a Non Disclosure Agreement ***(NDA)*** *with the Topic Manager.*

Therefore the applicant who is willing to receive this detailed info package, is invited to write to the call mailbox confirming the request. He'll receive a NDA to sign in two originals and to send to the JU.

The NDA will be passed to the Topic Manager and, when signed, will be returned in one copy to the applicant together with the Specification document.

Questions concerning the confidential data delivered will be handled in a dedicated Q/A document, which will only be circulated to those applicants who have signed the Confidentiality Agreement.

1. Background

The Smart Operations on Ground (SOG) concept has appeared at the end of the 60's. It was consisting in adding an hydraulic motor within the wheel of the nose landing gear of an aircraft. This concept was not integrated on existing aircraft, maybe due to the fact that these systems were too heavy and not enough efficient and also because of engine reliability to allow engine start on the taxiway.

Since few years, due to significant evolution in electrical technologies, many companies have started to work on this subject and several patents have been issued.
These companies are currently working systems based on wheel actuators integrated into Nose landing gear wheels. Clean Sky SGO members point of view is that these solutions are not optimal, mainly due to a too small availability of such system under degraded environmental conditions.

An alternative solution, which consists in developing a wheel actuator integrated on the main landing gear, will be attractive and relevant as it will provide a high availability rate.

2. Scope of work

One of the main critical points in the development of the SOG system is the demonstration of the technical feasibility of integrating a wheel actuator into the wheel, brake & landing gear environment. As a matter of fact, this integration shall deal with huge environmental constraints such as :

- A small available volume
- Thermal field (integration close to the brake, constraining thermal duty cycle)
- Mechanical environment (vibrations, shocks, deformations, …)

This CfP aims at designing, manufacturing and testing a wheel actuator which fits with these constraints.

In order to focus on integration difficulties, the wheel actuator design shall be based on existing and mature motor technologies. The key and innovative stake will be the integration of a wheel actuator based on conventional technology but fitting in a small volume and a harsh environment.

3. Type of work

1. Design of an electromechanical Wheel Actuator
   - Architecture and technology study and choice
   - Joined integration studies with SGO member (plateau Phase)
   - Preliminary and detailed design
2. Manufacturing of a Wheel Actuator Demonstrator
3. Test of the Wheel Actuator Demonstrator
   - Acceptance Test
   - Performance Tests
   - Endurance / Thermal Tests
4. Technical support to SGO Member Team during Wheel Actuator integration at SOG system level

The plateau phase will be held at SGO member premises near Paris.

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

- Expert skills in electromechanical actuator design
- Knowledge of aeronautical regulations and rules

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Wheel Actuator Architecture		T0 + 4 months
D2	Conformity matrix vs. Specification		T0 + 4 months
D3	Wheel Actuator envelop		T0 + 4 months
D4	Wheel Actuator ICD	Interface Control Document	T0 + 4 months
D5	Wheel Actuator DJP	Definition Justification Plan	T0 + 4 months
D6	Actuator 3D model		T0 + 7 months
D7	Actuator Component Specification		T0 + 7 months
D8	Tests programs, Acceptance Test Procedure		T0 + 11 months
D9	Wheel Actuator Prototype		T0 + 14 months
D10	DJD	Definition Justification Dossier	T0 + 16 months
D11	Tests reports		T0 + 16 months

T0 must be understood as the kick-off of this project.

6. Topic value (€)

The **maximum value** for this topic is

650,000 €
[six hundred fifty thousand euro]

Please note any proposal above this value will be NOT be eligible.

7. Remarks

Clean Sky Joint Undertaking
JTI-CS-2010-5-SGO-03-013

Topic description

CfP Nbr	Title		
JTI-CS-2010-5-SGO-03-013	Economical analysis according to business jets operators profile.	**Start date**	01/03/2011
		End date	01/04/2012

1. Background

The Clean Sky project, Systems for Green Operations ITD, is looking for a new partner of the ITD, able to provide an economical analysis of how business jets operators take into account the environmental constraints in their operations. The applicants shall have direct experience of the operations of individual private owners and/or companies operating a fleet of business jets.

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 (CO_2 and NO_x) 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 trajectory for the selected 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 operators, which influence their choices, the operational “cost” of trajectory will also be assessed.

Implementation of these optimisations is foreseen mainly on-board, in an avionics computer, or also on ground, using computing tools for flight preparation. The activities of MTM will bring implementation prototypes of these technologies to avionics systems demonstration platforms.

Context of use

Assessment of environmental performance achieved by the aircraft trajectory should be balanced with the global operating cost, which encompass usual operating cost (fuel, maintenance, …) and environmental taxes, to bring out the overall benefit.

Tomorrow flight optimisation will address additional environmental criteria to reduce noise and gaseous emission.

This topic looks after an economical analysis of how business jet operators include the environmental impacts in their flight management.

2. Scope of work

Description of work

The consortium wishes to enter into partnership with a supplier able to establish an analysis report responding to the following general requirements.

The new partner will perform the activities below:

(A) Assess actual flights environmental performance

Assess typical environmental performance of actual business jets flights compared to optimal trajectory computed for a given flight plan. This work will be used as a basis for quantified optimisation of trajectories.

The method to achieve this task shall be proposed by the applicant depending on the availability of actual flights data for business jets.

Expected activities are as follows:

- Provide a database of actual business jet trajectories, covering the various types of aircraft, routes and type of operations.
- Define the key flight characteristics expected to be analysed from an environmental impact perspective.
- According to the previously defined criteria, select a set of representative flights among those available in the actual flights records database.
- Perform a dispersion analysis of aircraft key parameters for flights along the selected routes in the flights database The deviations should be characterised per flight phase and possible root causes analysed.
- Extract, process, and synthesise available aircraft recorded data for flights along selected routes to allow comparison of environmental performance of actual flights and Clean Sky optimised flights in the project simulation environment

(B) Analyse current operators practices and operating costs

- Analyse how current flight optimisation is managed by the operators (e.g.: Is this optimisation under pilot responsibility? Is it predefined by operator's policy? What kind of refuelling policies are in place?etc)
- Describe and classify the different cost models according to bizjet operating context : privately owned aircraft, corporate jets, rental aircraft, passenger transport service…
- Identify how these costs are taken into account by the operators: either on a mission per mission basis, or on a fleet wide basis, or an annual or seasonal basis…

(C) Analyse environmental issues impacts and costs on operations

- Identify the current costs associated with environmental aspects: taxes, permits and quota, such as ETS regulations. Revenue sources should also be considered, such as the impact of a greener brand image. *This analysis shall focus on specificities only applicable to business jets*.
- Survey envisioned mid term evolutions of system of trading and environmental control. Get general trends of environmental costs with regard to mission profile
- *This analysis shall focus on specificities only applicable to business jets*.
- Analyse how tomorrow flight optimisation will be managed by the operators, with concurrent operation costs and environmental impacts (Noise, CO_2 and NOX emissions). Collect what are the priorities for this kind of operators regarding this issue. Collect the expectations of the operators in terms of solutions to integrate in their operations.

Requirements and constraints

The general requirements are the following:

Analysis content

A survey of the different business jet operators profiles and operating modes shall be provided

The aimed economical and operational analysis shall encompass business jet operations cost/benefit analysis.

A survey of the different charging policies of existing airports used by business jets shall also be performed.

Expected recorded flight data

The analysis of actual flights data depends on the availability of this kind of data for business jets. The supplier of the analysis may propose the most appropriate available source for these data.

The following descriptions should be taken only as guidelines:

Preliminary key characteristics of flights:

- Typical missions range : 300NM / 800NM / 1900NM / 5000NM
- All types of business jet aircrafts (segmentation of business aircraft categories is to be defined)
- Airport categories: large /medium / small (e.g. Eurocontrol categories)
- Categories are to be defined, with several flight data for each category (typically 20 flights per category) to allow statistical analysis.
- Interest in specific flight profiles, such as experimental approach (CDA, RNP AR, …)

Preliminary definition of data expected for each flight:

- Type of operator
- Type of aircraft: model, engine type & number, age of aircraft
- Pax number
- Pre flight data: filed flight plan, runway planned (take-off and landing), pre-flight FMS settings
- Trajectory description (from push back to parking): runway actually used (take-off and landing), aircraft position/attitudes/speeds, gross weight, engine states (fuel flow, …), auto-pilot and auto-throttle modes and targets (altitude, speeds, etc), aircraft configuration (high lift, landing gear, airbrakes, …), measured air data (temperature, pressure, wind).

The resolutions, time samples or volumes required for these data are to be defined.

Recorded flight data should be provided as simple text files (e.g. tab separator) with a detailed description of the data model and interface document.

Support

The partner organization shall have the capability to maintain the business model analysis and aircraft data reference – i.e. to further adapt or refine the analysis.

3. Type of work

Establish an economical analysis report of how business jet operators include the environmental issues impacts on their flight management and operations.

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

The candidate organization or consortium shall include in the answer to this call for proposal a detailed description of the analysis process and sources of data with the associated evidence of the expertise and pre-existing know how.

Participation of one or more Business Jet operators in the candidate organisation or consortium would be an asset.

5. Major deliverables and schedule

Note that proposed dates for deliverable are assuming final and accepted version. A review period before the deadline shall be taken into account by the applicant.

Deliverable	Title	Description (if applicable)	Due date
D1	Flight key characteristics definition and actual flight selection proposal	The content of this document is defined and agreed in cooperation with the topic manager or his appointed representative, through technical workshops.	01.06.2011
D2	Preliminary business analysis report for business jet operators	The content of this document is defined and agreed in cooperation with the topic manager or his appointed representative, through technical workshops.	01.09.2011
D3	Aircraft data dispersion per flight phase analysis report		15.10.2011
D4	Final business analysis report for business jet operators	This deliverable will be accepted through an acceptance review led by the topic manager.	**Major milestone: 01.12.2011**
D5	Supplements and updates of the business analysis- Provision of additional flights data		01.04.2012

6. Topic value (€)

The total value of this work package shall not exceed:

250,000.--€
[two hundred and fifty thousand euro]

Please note any proposal above this value will be NOT be eligible.

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
- Status of the deliverables and review milestones

Meeting and review policy

- Management & progress meetings shall be periodically planned and organized by the applicant – typically monghthly - 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.

Clean Sky Joint Undertaking
JTI-CS-2010-5-SGO-04-001

Topic description

CfP Nbr	Title		
JTI-CS-2010-5-SGO-04-001	Design and manufacture of an aircraft tractor compliant with specifications for Smart Operations on ground	**End date**	01.04.2012
		Start date	01.03.2011

1. Background

Clean Sky Systems for Green Operations aims developing systems that will reduce the environmental impact of the aircraft. In this project, work package 4 (WP4) aims at demonstrating the technical solutions for large aircraft application, both on ground test rigs and flight test aircraft.

The Dispatch Towing that consists in towing aircraft with engine off from gate to runway has been identified as a promising solution for greener aircraft operations. Today's aircraft have not been designed for this kind of operation. On the other hand, a procedure such as the Dispatch towing will be defined only if it can be applicable to all the aircraft operating on a platform. As a consequence, the design of a specific Dispatch Towing Vehicle (DTV) is required to overcome the limitations of current aircraft.

This DTV prototype will then be used during trials with real aircraft to validate its performance and its compliance to the defined requirements in order to prove the relevance of the concept.

2. Scope of work

The expected work is to design and manufacture a specific Dispatch Towing Vehicle (DTV) able to perform Dispatch Towing regardless the limitations of current aircraft. This platform is a TRL6 demonstrator of the Dispatch Towing concept.

This vehicle will have to fulfil the following requirements:

- The DTV must fulfil the International Standard used for Aircraft ground equipments (when applicable). The list of these standards is given in section 7.
- The DTV must tow aircraft at a speed compatible with the integration into the taxiing traffic.
- The DTV must not impact the structure life of the aircraft, and specifically the fuselage and the nose landing gear (it is the main limitation of current tow tugs)
- The aircraft pilot must be able to drive the DTV as long as it is attached to the aircraft; the behaviour of the DTV during turns and braking must give the feeling to the pilot that he is directly in control of the aircraft
- The DTV must propose a solution that ensures the safety of the aircraft during the towing operation: localisation, obstacle detection and aircraft guidance…
- The DTV must be universal in its aircraft category. Three aircraft categories are identified:
    - Regional aircraft
    - Single aisle (e.g. A320…)
    - Twin aisle (e.g. A330, A380…)
- The DTV must propose solutions to improve the reliability level compared to current towing vehicles
- The DTV may propose green solution for its own power system

The applicant will design and build a prototype of DTV for single aisle or for twin aisle aircraft family.

The technical concept will be validated versus requirements thanks to a dedicated analysis.

The necessary technologies will be developed or acquired by the applicant. Most of them already exist in other industries (e.g. automotive). Airbus is currently working on the demonstration of some of these technologies. They are not the property of Airbus, and the applicant has the freedom to acquire them by negotiating directly with the technology owner before answering to this CfP.

The value of the proposal will come from the integration of these technologies into a single vehicle fulfilling the requirements.

The relevant aircraft data will be provided on demand by Airbus during the negotiation phase with the selected applicant.

The purpose of Clean Sky is to evaluate and validate the performance of this demonstrator in a real operational use case. Hence the demonstrator will have to be physically delivered for some validation tests in France and the selected partners shall offer support during a 6 weeks trial period.

The physical property of the demonstrator belongs to the applicant unless other agreement during the negotiation report.

3. Type of work

The expected work will cover specification, design and manufacturing aspects.

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

The applicant must have experience on the manufacturing of ground vehicles for industrial application, and must show a deep understanding of the aircraft towing technical stakes.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	DTV Specifications		01.05.2010
D2	DTV Validation Report	Analysis showing the compliance of the selected technical solution versus the requirements	30.11.2011
D3	DTV Prototype		01.04.2012

6. Topic value (€)

The **maximum value** for this topic is

2,000,000 €
[two millions euro]

Please note any proposal above this value will be NOT be eligible.

7. Remarks

List of applicable International standard (not exhaustive) for the development of the DTV.

ISO	6966-1	Aircraft Ground Equipment – Basic Requirements – Part 1: General Design Requirements
	6966-2	Aircraft Ground Equipment – Basic Requirements – Part 2: Safety requirements
	20683-1	Aircraft Ground Equipment – Design, Test and maintenance for towbarless towing vehicles (TLTV) interfaced with nose landing gear – Main line aircraft
SAE	ARP1247C	General requirements for Aerospace Ground Support Equipment, Motorized and Non motorized
	AIR 1328	Aircraft support equipment stability analysis
	AIR 1375B	Minimum Safety Requirements for special purpose airline ground support equipment
	AIR 1838	Pictograms for ground support equipment
	ARP 4852	Design Specification for towbarless push-back tow vehicles
	ARP 4853	Design specification for towbarless tow vehicles
	ARP 5283	Nose gear towbarless tow vehicle basic test requirements
	ARP 5284	TLTV – Aircraft NLG steering and tractive force protection systems or alerting devices – inspection, maintenance and calibration requirements
	ARP 5285	Aircraft Towbarless towing vehicle operating procedure
EN	12312-7	Airvraft movement equipment

Clean Sky - Technology Evaluator

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-TEV	Clean Sky - Technology Evaluator	0		

No topics from Technology Evaluator are included in this call.