European Commission
Research Directorates

Call for Proposals:

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

Call Text

Call Identifier

SP1-JTI-CS-2011-03

Index

Document track changes

Page/topic	*Original*	*Correction or modification*

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- Topic manager (not to be published)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: yyyyyyyyy

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

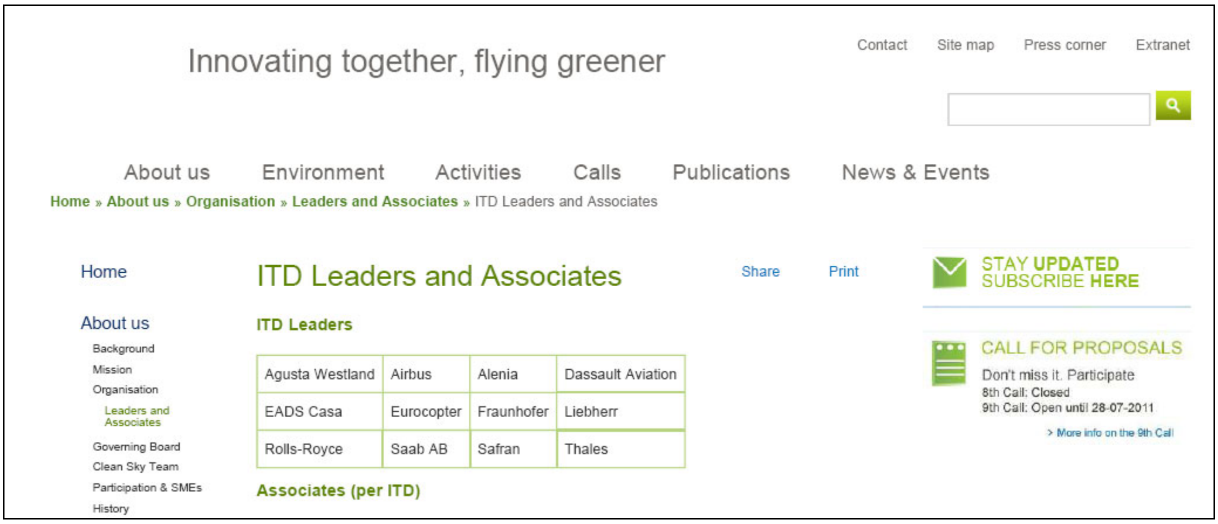
Make sure this total amount is below the value of the topic!!
Better, keep at least 5% margin.
Final amount is to be discussed in the negotiation.

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.

Pls check on the Clean Sky web site the composition of the ITDs in the dedicated page:



Evaluation

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: 19 July 2011**
- **Call close: 12 October 2011, 17:00**

- Evaluations (indicative): 14-18 November 2011

- Start of negotiations (indicative): 19 December 2011
- Final date for signature of GA by Partner: 31 January 2012
- Final date for signature of GA by Clean Sky JU: 15 February 2012

Recommendation to get a PIC

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-2011-03@cleansky.eu

Questions received until **1 September 2011** will be considered.

A first version of the Q/A document will be released by **9 September 2011**.

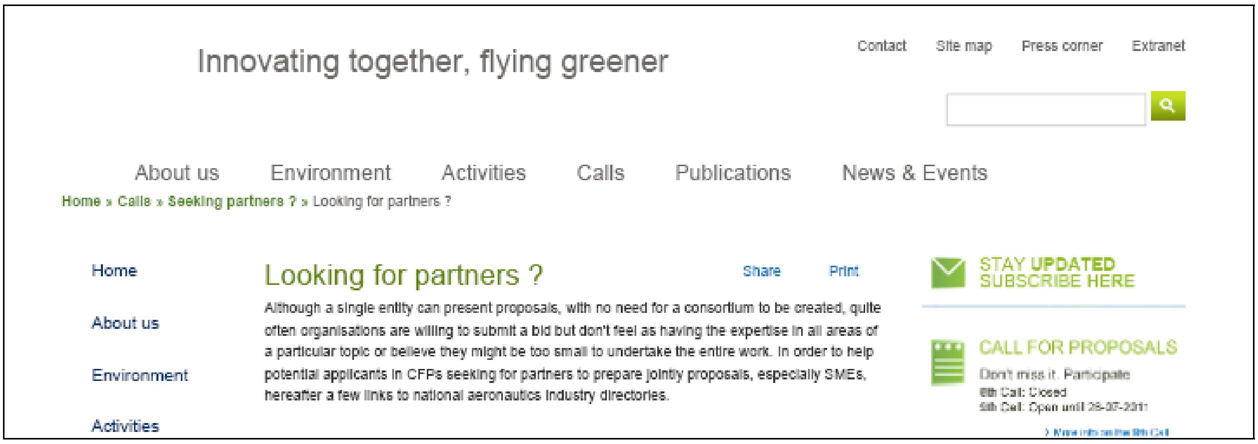
The final version of the Q/A document will be released by **21 September 2011**.

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), together with the answers provided by the topic managers.

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

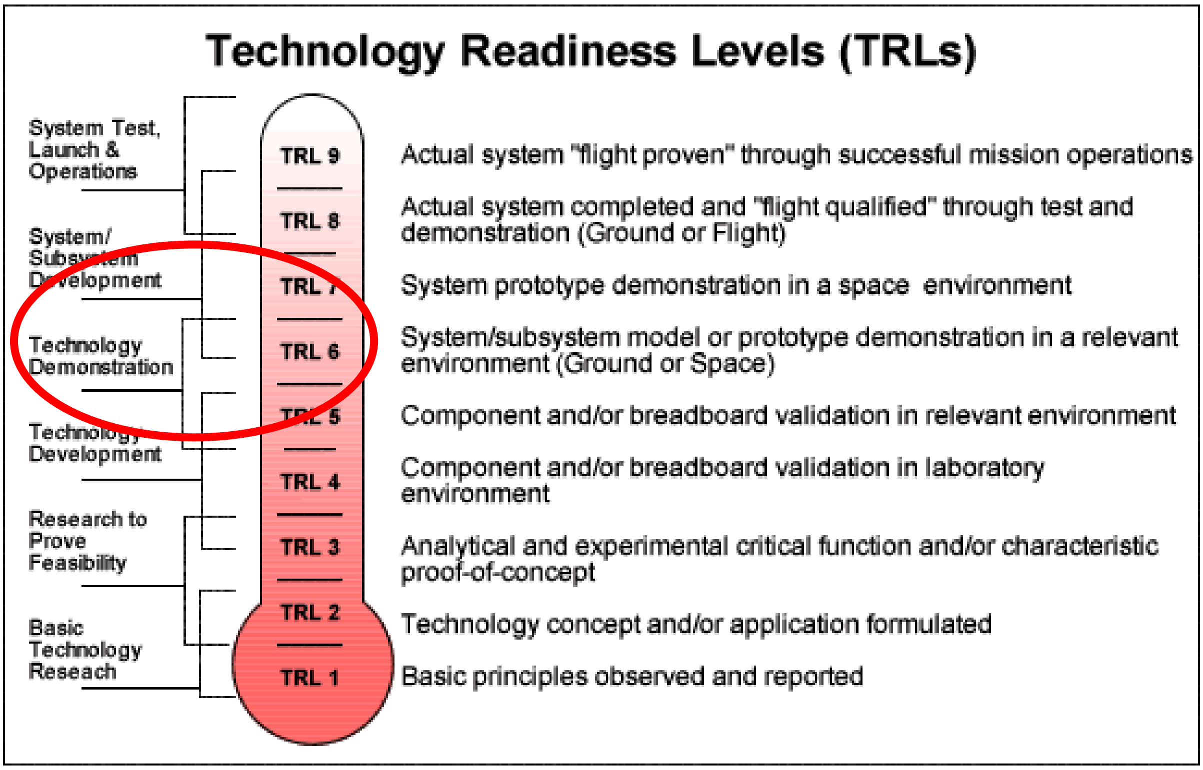
Looking for Partners?

If you are interested in checking available partners for a consortium to prepare a proposal, please be aware that on the Clean Sky web site there is a specific area with links to several databases of national aeronautical directories:



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:



Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-ECO	**Clean Sky - EcoDesign**	10	2.535.000	1.901.250
JTI-CS-ECO-01	*Area-01 - EDA (Eco-Design for Airframe)*		2.285.000	
JTI-CS-2011-3-ECO-01-032	Formulation and characterisation of new aluminium alloys for high temperature applications (250°C)		450.000	
JTI-CS-2011-3-ECO-01-033	Corrosion protection of aluminium unpainted parts: development of an appropriated Cr free sealing		240.000	
JTI-CS-2011-3-ECO-01-034	Metal recycling from a/c sources: Recycling routes screening and metallurgical approaches		200.000	
JTI-CS-2011-3-ECO-01-035	Environmental friendly ancillary materials development: Bio-sourced material, Recycled sourced mat.		160.000	
JTI-CS-2011-3-ECO-01-036	Development of fungi growth inhibition coating for fuel tank		300.000	
JTI-CS-2011-3-ECO-01-037	Disintegration of Fiber Reinforced Composites by electrodynamic fragmentation technique		435.000	
JTI-CS-2011-3-ECO-01-038	Aircraft insulation recycling routes and experiments		200.000	
JTI-CS-2011-3-ECO-01-039	Development of a chromate 6+ free chemical surface treatment for cast magnesium alloys protection		200.000	
JTI-CS-2011-3-ECO-01-040	Devel. of a fully automated preforming process for 3-D shaped composite dry fiber		300.000	
JTI-CS-ECO-02	*Area-02 - EDS (Eco-Design for Systems)*		250.000	
JTI-CS-2011-3-ECO-02-012	Intelligent Load Power Management Rig Module		250.000	
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	8	3.400.000	2.550.000
JTI-CS-GRA-01	*Area-01 - Low weight configurations*		750.000	
JTI-CS-2011-3-GRA-01-039	Hybrid laminates Industrialization for a/c nose fuselage/cockpit		300.000	
JTI-CS-2011-3-GRA-01-040	Nose Fuselage/Cockpit dynamic characterization for internal noise attenuation		200.000	
JTI-CS-2011-3-GRA-01-041	Optimal tooling system for design for large composite parts		250.000	
JTI-CS-GRA-02	*Area-02 - Low noise configurations*		2.150.000	
JTI-CS-2011-3-GRA-02-017	Advanced low noise Main and Nose Landing Gears for Regional Aircraft -Trade off concept studies		2.000.000	
JTI-CS-2011-3-GRA-02-018	Low Noise Devices aeroacoustics numerical Simulation		150.000	
JTI-CS-GRA-03	*Area-03 - All electric aircraft*		500.000	
JTI-CS-2011-3-GRA-03-006	Development and manufacturing of Programmable Electrical Loads and advanced Power Supply		100.000	
JTI-CS-2011-3-GRA-03-007	Improvement of numerical models for JTI/GRA Shared Simulation Environment		150.000	
JTI-CS-2011-3-GRA-03-008	Control Console and Electrical Power Center for In-Flight Demo		250.000	
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**	3	1.322.000	991.500
JTI-CS-GRC-01	*Area-01 - Innovative Rotor Blades*			
JTI-CS-GRC-02	*Area-02 - Reduced Drag of rotorcraft*			
JTI-CS-GRC-03	*Area-03 - Integration of innovative electrical systems*		1.122.000	
JTI-CS-2011-3-GRC-03-010	Advanced programmable Loads for Electrical Test Bench		210.000	
JTI-CS-2011-3-GRC-03-011	Multi-source regenerative systems power conversion		912.000	
JTI-CS-GRC-04	*Area-04 - Installation of diesel engines on light helicopters*			
JTI-CS-GRC-05	*Area-05 - Environmentally friendly flight paths*			
JTI-CS-GRC-06	*Area-06 - Eco Design for Rotorcraft*		200.000	
JTI-CS-2011-3-GRC-06-004	Dismantling and recycling of ecodesigned helicopter demonstrators		200.000	
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	4	7.400.000	5.550.000
JTI-CS-SAGE-01	*Area-01 - Geared Open Rotor*			
JTI-CS-SAGE-02	*Area-02 - Direct Drive Open Rotor*		6.200.000	
JTI-CS-2011-3-SAGE-02-009	CROR Propeller blades		4.000.000	
JTI-CS-2011-3-SAGE-02-010	Contra-Rotating Open Rotor (CROR) Propeller barrels		2.200.000	
JTI-CS-SAGE-03	*Area-03 - Large 3-shaft turbofan*			
JTI-CS-SAGE-04	*Area-04 - Geared Turbofan*		1.200.000	
JTI-CS-2011-3-SAGE-04-017	Integration of an Acoustic Absorber into the Turbine Exit Casing (TEC)		500.000	
JTI-CS-2011-3-SAGE-04-018	Development of a Microwave Clearance Measurement System for Low Pressure Turbines		700.000	
JTI-CS-SAGE-05	*Area-05 - Turboshaft*		0	
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	5	5.650.000	4.237.500
JTI-CS-SFWA-01	*Area01 – Smart Wing Technology*			
JTI-CS-SFWA-02	*Area02 - New Configuration*		5.650.000	
JTI-CS-2011-3-SFWA-02-019	Investigation of Bird Strike criteria for Natural Laminar Flow wings		800.000	
JTI-CS-2011-3-SFWA-02-020	Development of an automated gap filler device		550.000	
JTI-CS-2011-3-SFWA-02-021	Fixed Leading Edge Structure and Systems Demonstrator for a Business Jet laminar wing		1.500.000	
JTI-CS-2011-3-SFWA-02-022	Design and manufacturing of an innovative cryogenic wind tunnel model with motorized empennage		1.300.000	
JTI-CS-2011-3-SFWA-02-023	Development, manufacturing and testing of two different High Load Small Space Rotary Gear Types		1.500.000	
JTI-CS-SFWA-03	*Area03 – Flight Demonstrators*		0	
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	10	5.690.000	4.267.500
JTI-CS-SGO-01	*Area-01 - Definition of Aircraft Solutions and explotation strategies*			
JTI-CS-SGO-02	*Area-02 - Management of Aircraft Energy*		2.400.000	
JTI-CS-2011-3-SGO-02-014	Construction of bespoke evaluation Power Modules		250.000	
JTI-CS-2011-3-SGO-02-021	Development of key technology components for high-power density power converters for rotorcraft		250.000	
JTI-CS-2011-3-SGO-02-033	Optimisation of coating for the opeartion of power electronis with "open box" -housing in high altitude and		500.000	
JTI-CS-2011-3-SGO-02-035	Disconect device for jam tolerant linear actuators		600.000	
JTI-CS-2011-3-SGO-02-036	Design and optimisation of locally reacting acoustic material		300.000	
JTI-CS-2011-3-SGO-02-037	Feasibility study of full SiC High Integrated Power Electronic Module (HIPEM) for Aeronautic Application		500.000	
JTI-CS-SGO-03	*Area-03 - Management of Trajectory and Mission*		2.540.000	
JTI-CS-2011-3-SGO-03-014	Smart Operations on Ground power electronic with energy recycling system		1.390.000	
JTI-CS-2011-3-SGO-03-015	Simplified noise models for real time on-board applications		400.000	
JTI-CS-2011-3-SGO-03-016	Development of an Electronic Fligth Bag platform with integrated A-WXR and Q-AI Agents SW		750.000	
JTI-CS-SGO-04	*Area-04 - Aircraft Demonstrators*		750.000	
JTI-CS-2011-3-SGO-04-004	Design and manufacturing of a flight worthy intake system (scoop/NACA divergent intake)		750.000	
JTI-CS-SGO-05	*Area-05 - Aircraft-level assessment and exploitation*			
JTI-CS-TEV	Clean Sky - Technology Evaluator	0	0	0,000
		topics	VALUE	FUND
	totals (€)	40	25.997.000	19.497.750

Clean Sky – Eco Design

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-ECO	**Clean Sky - EcoDesign**	**10**	**2.535.000**	**1.901.250**
JTI-CS-ECO-01	*Area-01 - EDA (Eco-Design for Airframe)*		**2.285.000**	
JTI-CS-2011-3-ECO-01-032	Formulation and characterisation of new aluminium alloys for high temperature applications (250°C)		450.000	
JTI-CS-2011-3-ECO-01-033	Corrosion protection of aluminium unpainted parts: development of an appropriated Cr free sealing		240.000	
JTI-CS-2011-3-ECO-01-034	Metal recycling from a/c sources: Recycling routes screening and metallurgical approaches		200.000	
JTI-CS-2011-3-ECO-01-035	Environmental friendly ancillary materials development: Bio-sourced material, Recycled sourced mat.		160.000	
JTI-CS-2011-3-ECO-01-036	Development of fungi growth inhibition coating for fuel tank		300.000	
JTI-CS-2011-3-ECO-01-037	Disintegration of Fiber Reinforced Composites by electrodynamic fragmentation technique		435.000	
JTI-CS-2011-3-ECO-01-038	Aircraft insulation recycling routes and experiments		200.000	
JTI-CS-2011-3-ECO-01-039	Development of a chromate 6+ free chemical surface treatment for cast magnesium alloys protection		200.000	
JTI-CS-2011-3-ECO-01-040	Devel. of a fully automated preforming process for 3-D shaped composite dry fiber		300.000	
JTI-CS-ECO-02	*Area-02 - EDS (Eco-Design for Systems)*		**250.000**	
JTI-CS-2011-3-ECO-02-012	Intelligent Load Power Management Rig Module		250.000	

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-ECO-01-032	**Formulation and characterisation of new aluminium alloys for high temperature applications (250°C)**	**End date**	*To + 24*
		Start date	*To*

1. Topic Description

Wrought Aluminium alloys (AA) are widely used in aeronautics applications because of their good mechanical properties associated to a low density. Nevertheless, commercialy available wrought AA only whistand temperatures up to 180°C. For higher temperature applications (200-250°C), such as regulating valves and actuator bodies for air treatment systems, cast alloy AU5NKZr is currently used by the topic manager. But this cast alloy generates many misruns casting. In addition to a possible mass reduction, developing new wrought AA will also enable reducing rejects. Moreover, development of wrought aluminium alloys keeping good mechanical properties at elevated temperature will allow the topic manager to replace AA2618 alloy for turbine and compressor wheels and, if mechanical properties are good enough, some stainless steel parts for weight reduction.

The objective of the call is the development (formulation and appropriated heat treatments) of wrough aluminium alloy(s) keeping good mechanical properties after long time exposure at elevated temperature (e.g. Rp0.2 ≥ 175 MPa after 1000 h at 250°C). Mechanical properties between 20°C and 250°C must be as stable as possible even after long time exposure.

The mechanical properties of the alloy(s) developed shall be studied in details: Rm, Rp0.2, A%, Young modulus between 25°C and 300°C, after 1 h and 1000 h exposure at those temperatures, fatigue and creep. Metallurgical studies after 1000 h, possibly supported by accelerated tests, shall be performed in order to be able to predict the evolution of the mechanical properties of the alloy(s) after 1000 h up to 10000 h.

Additionally to its (their) ability(ies) to work at elevated temperature:

- corrosion resistance of the new alloy(s) shall be considered in order to limit surface treatments. Corrosion resistance is expected to be equivalent to the AA 2000 serial one,

- machinability shall be considered and is expected to be equivalent to the AA 2000 serial one , thus MMC (Metal Matrix Composites) won't be considered as a good reply to this call. The alloys could be formed, machined and finished using standard aluminium industry practices

Finally the recyclability, the production process and the cost of such alloy(s) shall be evaluated. The cost shall remain in the range of those of AA available today. Environmental impact of the production process needs also to be considered.

TRL4 is expected at the end of the project.

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

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

- strong knowledge on formulation and **thermal ageing of aluminium alloys**,
- extensive experience on and capabilities for mechanical and metallurgical characterisation of aluminium alloys,
- extensive experience on and capabilities for producing aluminium alloys.

The applicant must have facilities for developing and producing new alloy(s) and performing mechanical and metallurgical tests.

It would be greatly appreciated if the applicant had facilities for implementing the process in an industrial scale.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Bibliography review on formulation of AA regarding their properties for the given application and production processes	Report	To + 2
D2	Updated bibliography review on formulation of AA regarding their properties for the given application and production processes	Report	T0 + 12
D3	Updated bibliography review on formulation of AA regarding their properties for the given application and production processes	Report	T0 + 18
D4	New formulated AA and appropriated heat treatment.	Samples	To + 18
D5	Mechanical and metallurgical characterisation of new formulated AA	Tests reports and synthesis	To + 18
D6	Prediction of the ageing behaviour of the formulated AA (after 1000h up to 10000h at 250°C)	Evaluation report	To + 22
D7	Technical, economical and environmental study of the new formulated AA production process	Report	To + 24

4. Topic value (€)

The total value of this work package shall not exceed:

450,000 €

[four hundred fifty thousand euro]

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

5. Remarks

This topic is focused on sealing processes for Sulfuric Acid Anodizing in order to protect unpainted aluminium parts. The applicant is required to verify the state of art also with respect to on-going or past projects on similar subjects.

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-ECO-01-033	**Corrosion protection of aluminium unpainted parts: development of an appropriated Cr free sealing process on thin SAA layer (≤ 5 µm)**	End date	*To + 24*
		Start date	*To*

1. Topic Description

Aluminium alloys are widely used in aeronautics applications. Nowadays, 95% of aluminium parts are protected by surface treatments in order to prevent corrosion. The surface treatment which is mainly used is Chromic Acid Anodizing coupled with its dichromate sealing (CAA), conversion coating (Alodine®) with or without painting and varnish. These protections contain the CMR compound Cr^{6+} or use it in their process (Cr^{6+} is used in the baths during the process, in the layer of conversion, in painting or in varnish). The Clean-Sky programme aims at developing green technologies that meet the European regulation such as the REACH regulation.

Thin layer (≤5 µm) sealed Sulphuric Acid Anodising (SAA) is a good alternative process for replacing sealed CAA for **aluminium unpainted parts**. Sealed SAA industrial processes are already on the industrial market providing thicker protective layers (in the range of 10 µm). The missing step to use this process as thin layer for unpainted parts is to develop a well suited sealing process to make sure that the treatment meets the corrosion resistance requirements (750 hours salt-spray).

A previous study on thin layer SAA performed within the topic manager background has already shown good results on one aluminium alloy (AA2024 laminated) and enabled defining the surface pickling and the SAA bath. The defined parameters will be shared with the partners as base for future work under an IPR agreement between the partners, the Topic Manager and its surface treatment supplier.

The aim of this CfP is to find partners that will propose a 2 years research program for developing thin layer **sealed** SAA coatings that will demonstrate good corrosion protection for aluminium unpainted parts. The main goal is to find an appropriate sealing process for the given **thin layer SAA (≤ 5 µm)**. As a second step, if good corrosion resistance results are obtained, the effects of the substrate composition (2024, 2618, AS7G06, AU5NKZR) and production process (cast, laminated, forged…) shall be evaluated on samples provided by the topic manager. Then, the technology transfer will be done towards the topic manager's SAA supplier. Finally, a part of the study needs to focus on process optimization for reducing energy consumption.

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

The partner or group of partners shall have facilities for implementing the whole process of sealed SAA coatings (pickling, anodizing and sealing) but also for characterizing them through salt spray testing, micro-structural observations, thickness measurements, electrochemichal measurements. It is requested to have the skills for performing the necessary analysis for the understanding of the sealing mechanisms, the species created and their interaction with the corrosion mechanisms.

The products used for the sealing process shall be in accordance with REACH regulation and compatible with an industrial transfer.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Bibliography of sealing process for SAA layer	Report	To + 6
D2	Thin layer SAA implementation and checking of the corrosion resistance	Coated samples + report	To + 8
D3	Sealing development for SAA treated AA 2024 and corrosion resistance characterisation	Coated samples + report	To + 16
D4	Study on substrate variation effects (nature, production process)	Coated samples + report	To + 22
D5	Optimisation of process parameters to minimize energy consumption and corrosion resistance characterisation	Report + technological transfer	To + 24

4. Topic value (€)

The total value of this work package shall not exceed:

240,000 €

[two hundred forty thousand euro]

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

5. Remarks

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-ECO-01-034	**Metal recycling: Recycling routes screening and metallurgical approaches**	**End date**	*T0+20*
		Start date	*T0*

1. Topic Description

As of today, metals form the most relevant materials share of a/c in operation, namely the 2000, 5000, 6000 and 7000 aluminum alloy series. Moreover, AlLi (8090-T3) and AlSc-alloys are available for a/c applications. If dismantled properly, kept and processed separately as shown in the PAMELA project, metals recycling into the initial quality proves feasible. Nevertheless no information nor technology is available to recover high grade alloys from these scrap materials. Thus the goal of this CfP is to develop a technology for the the real-life recycling of these a/c alloys and to demonstrate it.

The steps of dismantling, metals recycling processes and alloy development based on recycled a/c alloys have to be described in detail and carried out in practital trials, providing a basis for material supply for the alloy development. It is expected that both currently widely used and new alloys which are currently not or very little used are taken into account, the latter on a theoretical scale only, although for these new or innovative alloys an assessment regarding their compatibilty with current recycling routes is expected.

The applicant is expected to describe and apply the current dismantling technologies for a/c, specifically focusing on metal parts, and to identify and measure the quality of dismantled parts and metals. Moreover, dismantling guideline information in a combined written/photographic format is expected along with metals samples from dismantling in order to compare the quality of scrap from different sources.

Regarding metals recycling, the expected outcome is an overview over all a/c alloys along with hands-on samples, giving specific information on each alloy amongst other on

-scrap quality requirements (e.g. removal of coatings, sealants)

-pre-treatment processes required/recommended/available

-processes and processors capable of recycling metals into standard alloys

-comment on batch size relevance (separate processing) in case a/c alloys are not fed into standard metals conversion processes.

It is expected that selected of these processes are applied in order to generate metals samples for the subsequent alloy development. The composition of metal scrap (either separated or non-separated alloys) has to be taken as a basis for selected alloy development utilizing the scrap (or scrap quality) from dismantling. It is expected that metallurgical information is compiled and used for conversion of standard alloys into other or new alloys. Moreover, it is expected that the applicant provides powder samples of selected Al alloys (AlCu4SiMg: 2014, AlCu: 2124, AlMg2,5: 5052, AlMg1SiCu: 6061, AlZn5,5MgCu: 7475, AlLi 8090) for experimental purposes.

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

The applying body or consortium is expected to have a track record in hands-on dismantling of large complex products such as e. g. cars, railcars, or possibly a/c, and in development of or contribution to recycling guidelines.

Moreover, in-depth practical and theoretical experiences in mechanical treatment of waste streams including sorting and grinding has to be available with the applicant.

Metallurgical competencies both on a theoretical and practical level have to be available including access to melting furnaces for practical trials.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Intermediate Synthesis Report	Report to describe in detail the state of the art including stakeholders, covering dismantling, design guidelines, processing, metallurgy , including updated work plan for remaining CfP project period	To + 10 Months
D2	Dismantling – Report and samples	Report on the dismantling trials including samples from dismantling, with alloys and potential recycling routes identified	To + 20 Months
D3	Report and presentation/workshop: Design for Recycling	Workshop with WP24 and WP33 participants to present and discuss intermediate results on recycling, and on aspects of design for recycling	To + 16 Months
D4	Processing– Report and samples	Report on the processing trials including samples and their composition and potential metallurgical routes identified	To + 20 Months
D5	Metallurgy– Report and samples	Report on the metallurgical trials including sample alloys and potential field of application in a/c identified	To + 20 Months

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

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-ECO-01-035	**Environmental friendly ancillary materials development**	**End date**	*To + 24*
		Start date	*To*

1. Topic Description

The manufacturing of composite structure component is using huge volume of ancillary materials (peel ply, release film, breather, vaccum bag, sealant tape, injection tubes, adhesive tapes...). The ancillary materials are involved in all steps of the manufacturing process: lay-up, compaction final bagging for curing, preforming/hot forming... and in all kind of conditions from room temperature up to 200°C with vacuum and pressure.

The ancillary materials are made of chemical polymer in film or fabrics (woven or non-woven). In most cases, all these materials are used one time and the pollution by the resin during the manufacturing process made them not suitable for recycling.

Innovative materials or bagging solution is of great interest for Cleansky by aiming at :

- reducing the volume of waste.
- having more recyclable or biodegradable materials.

This call for proposal objectives are:

- to develop and adapt the use of innovative materials and polymer in the manufacturing of aeronautic structure components,
- to integrate functions on the material to reduce the number of different materials used,
- to improve the use of reusable materials.

The materials shall be suitable for carbon fibres reinforced epoxy resin structural parts manufactured in autoclave or liquid resin process. The product shall not be degradated under conditions of 7 to 8 bars pressure and curing temperature of 190°C during 4 hours. In case of reusable materials, they shall resist to at least 5 times the standard curing conditions without being degradated.

The proposed solution have to be in accordance with one or more of the following objectives:

- Use of bio-polymer, bio-sourced materials
- Be recyclable or made with recycled materials,
- Reusable several times to reduce the waste volume
- Be with integrated functions to reduce the volume of waste, number of layer, and number of different polymer.
- Without VOC.
- Be innovative with new materials or bagging concept.

The work axis requested are the following:

- Replacement of breather fabrics (non woven fabric) made of polyester, polyamide polymer or glass fabrics by bio sourced fibers, polymers or recycled polymers.
- Adapt existing biosourced or biodegradable polymers to bagging film application.
- Adapt existing biosourced or biodegradable polymers for release film application.
- Adapt existing biosourced or biodegradable polymers for peel ply application ensuring the good resin flow and surface roughness for further application (e.g.: painting, bonding, ...)
- Integrate functions on reusable bagging membrane (silicone, latex, elastomer...): e.g. breathing for airflow, release property, ...

New product and solution shall be mature enough for implementation on demonstrator at the end of the project. The dimensions shall be suitable for part over 2.5m * 2.5m size. The proposal could be either innovative materials or bagging concept. The solution can be appllicable to one step or more in the manufacturing process.

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

Skills required :
- Experience in composite manufacturing
- Experience in polymer materials, polymer films, fabrics (all types).

Equipment:
- All type of equipment used in the composite manufacturing is recommended.
- Equipment for film and/or fabric manufacturing is also recommended.

Certification:
- ISO14001 is recommended

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Solution proposal	- Synthesis of the proposals in term of materials, bagging concept or any other innovative solution. - Development schedule.	To + 3 Months
D2	Sample presentation	- Manufacturing of samples.	To + 6 months
D3	Sample characterisation	- Technical report including material characterisation.	To + 9months
D4	Shop trials at lab scale (Panels of max 1m x 1m.)	- Technical report with shop trials in laboratory conditions.	To + 12 months
D5	Shop trials in industrial conditions (Stiffened panels, approximate dimensions 2.5m*2.5m.)	- Technical report showing the use of material on industrial part:	T0+18 months
D6	Final report	- Synthesis presenting the solutions, materials, ... - Full material characterisation (if applicable) - Shop trials at lab and on real part. - Implementation plan.	T0+24 months

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 applicant is required to verify the state of art also with respect to on-going or past projects on similar subjects, as well as on patents and commercial system available

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-ECO-01-036	**Development of fungi growth inhibition coating for fuel tank**	**End date**	*To + 24*
		Start date	*To*

1. Topic Description

The objective is to formulate an innovative coating capable to inhibite fungi adhesion and growth in fuel tank area. This coating will be applied over non nutrient chromate free primer. The coating shall:

- provide long term inhibition
- provide non adhesion of fungi
- be chemically bond to chromate free primer
- be compatible with fuel and will not affect fuel combustion

Preferred solution is a sprayable solution which ensures non adhesion and inhibition without any degradation of fuel properties. But dual mechanism to control the release rate of inhibitor will be also considered.

The functional coating can include active molecular species specifically dedicated to fungi growth inhibition, purification and disinfection. More specifically nanostructured organic and inorganic coatings with embedded catalytically active metal or metal oxide particles can be considered.

The formulation and deposition of the functional coating should be based on innovative and green processes.

Potential safety issues related to the synthesis and handling of nanoparticles and nanostructured materials need to be adressed.

The core of the consortium shall integrate a paint/coating supplier and a highly skilled biological laboratory having a good knowledge in microorganisms present in aircraft fuel.

It is expected from the applicants the following:

*State of the art of non adhesion of fungi and inhibition of fungi growthand strategy of development

*Main routes to synthesis and produce relevant product(s) and coating

*Mechanism of grafting over epoxy primer used for corrosion protection in fuel tank

*Demonstration that the developed formulation has not detrimental effect on fuel

*Clear definition of milestones to monitor the development

*Role of each partner and synergies

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

- Good knowledge of fungi present in fuel tank and good knowledge of their metabolism.
- Knowledge in bacterial and fungal adhesion mechanism, bio-film formation and surface corrosion mechanism
- Design and Synthesis of active molecular species dedicated to inhibit fungi adhesion and growth
- Deposition techniques and characterization of functional coatings
- Knowledge in environmentally friendly chemistry and green processes
- Skills to evaluate the antimicrobial effects of the coating and quantify the adhesion of microorganism in surface

Equipment and infrastructure:

Infrastructure to produce nanostructured functional coatings using green processes

Equipment for materials and coatings characterization (SEM, Ellipsometer, XPS, XRay, ...)

Equipment to measure antimicrobial effects of the coating and the adhesion of microorganism (Enumeration, Optical Microscopy, Scanning Electron Microscopy, Confocal (Laser Scanning) Microscopy, Atomic Force Microscopy)

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	List of tests to assess fungi growth inhibition		To + 6
D2	Interaction with fungi to ensure inhibition		T0+6
D3	Screening of inhibition mechanism-Validation		T0+8
D4	Synthesis of inhibitors		T0+15
D5	Development of a coating		T0+20
D6	Biological activity		T0+24

4. Topic value (€)

The total value of this work package shall not exceed:

€ 300 000

[three hundred thousand euro]

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

5. Remarks

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-ECO-01-037	**Disintegration of fibre-reinforced composites by electrodynamic fragmentation technique**	**End date**	*T0+20*
		Start date	*T0*

1. Topic Description

Recycling of CFRP's like thermosets, thermoplasts or similar fibre-reinforced composites with the goal to separate the embedded carbon fibres from the surrounding polymer matrix is a difficult task. The processing of CFRP's by mechanical grinding methods results only in comminuted samples, but not in a selective detachment of the fibres from the polymer matrices which mainly consist of epoxy based binders or polyether ether ketone (PEEK). Furthermore, carbon-fibres can be damaged by the impact of crushing mills which reduces significantly their recyclability. Other processes like pyrolysis or chemical treatment methods seem to be too energy or material demanding to become economically viable. A promising method to disintegrate fibre-reinforced composites or fibre-metal-laminates selectively into polymers and fibres is the so-called electrodynamic fragmentation, which is a special adaptation of a pulsed power processing technique. This method is based on the physical principle that an electrical discharge in a solid takes preferably the line along phase boundaries and thereby disintegrates a composite into its compounds. If the process is conducted in a closed vessel filled with water or other suitable dielectric liquids, the electrical discharge generates shock waves, which intensify the disintegration.

The objective of the call is to implement a specific electrodynamic fragmentation technology for processing CFRP's. A fragmentation of CFRP's into their main constituent parts fibres and polymers (+ metals) will significantly increase their recyclability. The focus is on the processing of thermosets, thermoplasts and fibre-metal-laminates with the goal to regain non-damaged high-quality carbon fibres, which can be reused with no or minor post-treatments. Therefore the design and construction of a pulsed power processing plant specifically for CFRP's have to be carried out by the applicant.

A suitable partner should be capable to perform following tasks:

Task 1:

Definition of process parameters and delivery of equipment specifications:

Initially, various samples of thermosets, thermoplasts and fibre-metal laminates shall be used in a lab scale plant to evaluate the optimum machine and processing parameters.

Following machine parameters are required for a pulsed power processing plant for CFRP's:

- High voltage (HV) cascade generator with variable voltage between 70 – 200 kV
- Variable pulse rise time between 5 – 10 Hz
- Movable electrodes to keep the optimum distance between electrodes and sample constant
- Variable electrode configurations (bulging disc, finger-shaped, mushroom-shaped, etc.) and variable electrode material (working steel, stainless steel, machine steel)
- Plant must possess an automated electrical grounding
- External tool for monitoring resistivity and currency per pulse

Task 2:

Evaluation of optimum parameters for processing CFRP's on lab-scale plant and provision of necessary input data for up-scaling and construction of a prototype

- Optimisation of most important parameters: a) distance between electrodes and samples and b) energy input (applied voltage).
- Maximisation of degree of deliberation (weight ratio of deliberated fibres / non deliberated fibres + polymers) as a function of energy input and electrode distance.
- Delivery of carbon fibres to project partners (recyclability of the obtained "deliberated" carbon fibres will be assessed externally (quality assurance)

If necessary, the process vessel and sieve inserts have to be modified in terms of shape and material.

Task 3:

Concept for up-scaling, design and construction of a demonstrator:

• Design of a continuously operating demonstrator with a high throughput rate for processing CFRP's, especially for thermosets, thermoplasts and fibre-metal-laminates

• Design of a processing vessel suitable for samples with at least 20 cm x 20 cm x 5 cm in size, ideally is a processing area for large or complex samples (> 1 m in length) e.g. for fuselage samples

• Apply a suitable filtration process to separate the carbon fibres from the process water

• Assurance of health and safety issues:

1) Achievement of EMC (Electro-magnetic compatibility), where different electric and electronic systems of the demonstrator have to operate without disturbing each other.

2) Apply EMS (electro-magnetic shielding) to guarantee a safe handling of the processing plant and the operators.

• Performance test and a cost – energy efficiency analysis have to be conducted

The applicant will be supported with regard to physical and chemical analysis of products.

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

The applicant (single organisation or consortium) should possess following:

• highly skilled in the development and adaptation of electrodynamic fragmentation techniques

• vast experience in mechanical engineering to design and build pulsed power processing facilities for various sorts of materials

• wide activity in the area of processing and recycling of composite materials

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Set up of equipment for machine and process parameters		To + 3 Months
D2	Optimisation of machine and process parameters on a lab-scale machine	Report	To + 6 Months
D3	Up-scaling, design and construction of a demonstrator	Technology transfer	To + 16 Months
D4	Evaluation of demonstrator performance and cost-energy efficiency analysis		To + 19 Months
D5	Final report		To + 20 Months

4. Topic value (€)

The total value of this work package shall not exceed:

€ 435.000

[four hundred thirty five thousand euro]

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

5. Remarks

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-ECO-01-038	**Aircraft Insulation recycling routes and experiments**	**End date**	*To + 20*
		Start date	*To*

1. Topic Description

Insulation materials is applied in aircraft (a/c) structures mainly to provide for thermal insulation During the use phase, it undergoes physical (thermal, mechanical) stresses. Amongst others, condensate accumulation in the insulation layer may contribute remarkably to the weight of aged a/c.

The goal of this CfP is to identify and to test the real-life recycling options of the insulation system (polymer bags plus insulation fibers) including a detailed description of the recycling process as well as production of recycling samples from a/c insulation materials. The primary focus is laid on the mineral portion of the insulation layer.

The following steps and research areas are expected to be adressed:

-Quanfication of insulation material mass in end of life a/c (airliners, business jets, rotorcrafts) and description of their end of life quality/properties including fiber length, moisture, assessment of the hazardousness of the insulation and bag material

-Identification and description of general recycling options for the insulation and bag material

-Acquisition of a/c insulation material samples for analytical tests and processing trials

-Treatment (e. g. sorting, mechanical, thermal treatment) of the insulation material in order to recycle the materials at the highest materials properties and value retained possible. The recycling experiments (hand-on trials) are expected to cover primary recycling and secondary recycling options: Primary recycling is expected to cover at minimum polymer (bag) materials recycling into samples to measure the mechanical properties and to identify other important properties such as e.g. flame retardancy, and fiber recovery for reinforcement purposes in polymer or other matrix materials. A minimum of five materials samples from polymers is to be produced and tested under this scheme. Secondary recycling is expected to cover at minimum thermal treatment of fibers in order to generate materials for building purposes. A minimum of three samples for different purposes (building applications) is expected to be produced. The products or fields of application in the building sector will have to be identified and described in detail. Samples from all trials including defined intermediate products along with the initial material samples will have to be handed over to the CS EDA consortium for free. It is expected that at minimum one final product made from polymers and three final fiber-based products will be made available to the consortium.

-Data for life cycle assessment will have to be handed over to the CS EDA consortium, in order to implement a LCA insulation recycling module into the LCA method. The scope and format of the data will be defined by the CS EDA consortium, and is expected to use the ELCD format.

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

The applying body or consortium is expected to have a proven track record in hands-on processing and recycling of fibrous insulation materials, especially for hazardous glass and mineral wool materials. Business operations in this field are highly appreciated. Moreover, access to or operation of chemical/analytical equipment for qualification of the initial material is necessary. The same applies to polymer processing and testing facilities (extrusion, injection moulding, testing facilities for materials properties, fiber length measurement).

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Kickoff meeting	Final agreement on work plan, contents, and time planning	T0+ 2 Months
D2	Insulation samples and testing plan	Insulation samples are available for testing in sufficient mass, testing plan is ready for execution, testing plan is agreed upon with CS EDA Consortium	To + 6 Months
D3	Overview report	Report covering identification and description of general recycling options for the insulation and bag material	To + 8 Months
D4	Intermediate recycling and testing report on practical trials	Meeting incl. Presentation and Minutes on practical trials progress, testing plan update, intermediate LCA data will be handed over to CS EDA	To + 12 Months
D5	Product Samples assessment	Presentation and handover of product samples, presentation of recycling facility (possibly on-site), assessment of product quality, testing schedule update	To + 16 Months
D6	Final Report	Providing detailed information on all CfP activities, especially on the practical recycling steps, results, products quality, Life cycle assessment data	To + 20 Months

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

Topic Description

CfP topic number	Title		
JTI-CS-2011-2-ECO-01-039	**Development of a chromate 6+ free- chemical surface treatment for cast magnesium alloys protection**	**End date**	*To + 12*
		Start date	*To*

1. Topic Description

Magnesium alloys castings are used as gearbox casings because of the advantages in terms of specific weight mechanical properties and suitability for the casting process.

The high susceptibility of Magnesium to corrosion is mitigated by the choice of alloys showing a good intrisic resistance to corrosion, but it still needs to be enhanced by the application of suitable protective treatments. Protective treatments of magnesium alloys besides their protective functions shall be suitable to be obtained without the use of dangerous CMR substances.
A green technology developing is part of the Clean Sky project and for this purpose one CfP topic was already launched to produce Micro Arc Oxidation coatings.
Besides the mentioned “Micro Arc”, which is an electo-chemical technology, which will hopefully satisfy the coating of most of the casting surfaces, there is the need to introduce also a **Chromium 6 free chemical coating technology** for those areas which are not suitably exposed for an electrochemical process, like oil ducts, very close tolerance mating surfaces, narrow holes or threaded fasteners seats.

This treatment shall have the following characteristics:

- Be suitable to be applied by immersion on the whole component or by brush or fill and drain in limited areas, considering that the remaining of the part is already protected by a previous inorganic treatment which is not part of this project (possibly micro arc) and a subsequent organic resin sealing. The sought treatment will then be applied typically on a newly finish-machined metallic surface

- Be suitable of being applied without the need of acid etching process steps or electrolytic cleaning steps, whereas alkaline cleaning is considered an acceptable preparation step

- Leave a thin conversion coating suitable to facilitate the adhesion of sealing resins and primers

- Provide substrate corrosion protection if wetted by transmission oil or temporary protective oil

- Be free of substances listed in the REACh candidate list or in the Priority Declarable Substance List issued by ASD (Aerospace Defence-Industries Association of Europe)

Some of those chemical treatments are already available on the market and were applied mainly in the automotive field or in the aerospace field on different magnesium alloys or possibly may need being modified to fulfil the requirements.

The aim of this CFP is to find partners to extend the application of those treatments to the helicopter transmission casting alloys (which are mentioned below) and performing the technical substantiation of the chemical solutions, mainly as a comparative testing with old fashioned chromated chemical treatments actually in use, namely processes AMS-M-3171 or DTD911.

The Partner shall consider that the topic manager will supply to the selected partner/partners cast specimens in one of the used alloys EV31A (AMS4429) or WE43 (AMS4427) with machined surfaced, and some with selectively protected and coated surfaces (commercially available permanent resin for helicopter transmission).

The Partner(s) shall select and provide the chemical treatment most suitable for the Magnesium alloy that will be selected by the topic manager as mentioned above and apply it with different methods (immersion, brush, fill and drain) according to process instructions to be formally issued in a document.

Trial tests to select the optimum treatment shall be part of the activity.

The treated samples shall show a uniform layer of conversion (chemical modification of the surface), indicating that the treatment has been effective in a uniform way. No signs of powdery coat shall appear.

After the application of the treatment the permanent resin coated areas shall show no signs of degradation (blisters, discoloration, pitting).

The Partner(s) shall provide corrosion testing in a mild environment of coated and oiled specimens and reference specimens (e.g. tests method as per MIL-STD 810 method 507.4 humidity test or similar method). The test result shall be a comparative ranking of the new treatment and the reference ones in terms of corrosion spots during an exposure time of the order of 500 hrs

The Partner(s) shall provide corrosion testing in salt fog environment ASTM B117 of coated and primed specimens and reference specimens. Resin coating and primer application after the new treatment shall be provided by the Partner using commercial materials indicated by the topic manager. The test result shall be a comparative ranking of the new treatment and the reference ones in terms of corrosion spots during an exposure time of the order of 2000 hrs

The partner(s) shall provide sufficient evidence of no geometrical changes deriving from the application of the treatment. Acceptable test method is as stated in AMS-S-3171

The partner(s) shall carry out primer adhesion tests using a standard methodology (e.g. ISO2409)

Reference coated specimens for comparison shall be supplied by the topic manager

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

The applicants should be a research laboratory and/or suppliers having foreground rights on chemical treatments suitable to be applied or modified for the chemical conversion of magnesium alloys. In alternative it could be a test laboratory with the possibility to find the chemical treatment on the market.

The applicant shall have facilities for characterizing coatings through salt spray testing, humidity testing, tape adhesion and dimensional measurements.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Selected conversion coating	Chemical preparation commercial or proprietary to the Partner (at least identification data are needed)	To + 6 Months
D2	Application procedure	Report with dilution data, temperature limits, preparation procedure	To + 6 Months
D3	Test results	Report showing relative ranking of the tested treatments (photographic documentation). Dimensional results. Adhesion test results	To + 12 Months
D4	Selected test articles	All tested Coupons	To + 12 Months

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

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-ECO-01-040	**Development of a fully automated preforming process for the production of 3-D shaped composite dry fiber profiles by using the energy efficient chemical stitching approach**	**End date**	To +18
		Start date	*To*

1. Topic Description

The objective is to develop an innovative fully automated preforming process for the production of dry continuous 3-D shaped and curved composite dry fiber profiles. The system's main task should be to preform profiles made from dry composite fiber materials like carbon fiber roving and different types of fabrics (semi-finished products) by using the new and high innovative chemical stitching preform approach.

The development of an automated preform process for continuous dry preforms shall allow the use of energy efficient liquid composite moulding (LCM) processes for large volume production instead of the currently used time and energy consuming autoclave processes. The use of the new chemical stitching approach developed and evaluated within CleanSky (in lab-scale to produce small and flat generic samples) shall further allow the prevention of time consuming binder application and binder activation process by use of in-situ curing of the applied adhesive points by energy efficient curing methods e.g. IR- or microwave- technology. On the basis of the existing, within CleanSky developed lab-scale assembly, an equipment manufacturer is required to develop an automated solution which is suitable for the build up of a stiffened panel demonstrator. The topic to bring the basic chemical stitching preform approach into an automated process requires a lot of research and development work from the equipment manufacturer caused by the singularity of the demanded process. In the preforming assisted by chemical stitching approach very small amount of the adhesive binder is used locally as a spot. Use of very less amount adhesive binder as a spot helps to maintain the permeability of the textiles. Hence the required impregnation time in the LCM process can be significantly reduced if compared to classically bindered textiles. The automated preforming shall be developed to serve various applied research and development activities. However, the equipment shall be designed and built as compact as possible.

The categories of the produced parts are profiles such as stringers (C or T-stringer) or ribs which are used in aircraft construction in high numbers.

The development includes:

- A gentle supply of dry bindered and unbindered textile carbon- and glassfibre semi finished products (like mats, veils, unidirectional and woven structures)
- Automated combination of these above mentioned individual semi-finished product single-layers to continuous fibre-packages or fibre-strings with a defined number of layers (number of layers should be adjustable before every production cycle)
- Forming of the previously produced fibre packages to profile structures like C or T-stringers at a given geometry (area cross-section of the profile maximum 30cm²).
- Fixation and stabilization of the formed single layers to a handable dry preform by using the energy efficient chemical stitching preforming approach. The binders have to be applied by injection needle with an inner diameter of maximum 1 mm. The binder material can be a hot melt (thermoplastic material) or reactive binders (curable thermoset material). The curing method for the reactive binders should be an energy efficient curing method.
- Production of demonstrator profiles (C-stringer), which are ready for integration in CS EDA WP2 "torsion box demonstrator".

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

Skills:
- Expertise in production of dry carbon-fibre preforms (for aviation)
- Good knowledge in automation of CFRP processes along the whole process chain (cutting, handling, draping, preforming and infiltration)
- Expertise in fast and good mixing and application of minimal amounts of reactive adhesives
- Basic knowledge (e.g. process idea, advantages, and process steps) for integrating the chemical stitching preform approach

Equipment:
- Equipment length: the initial maximum available length for fixed built machine parts is 10,0m
- Equipment width: the maximum available width for the equipment (including area on both machine sides for the operator) is 4,0m
- A supply frame for the fibre products shall be used to support both glass fibre and carbon fibre semi-finished products having different orientations (mats, veils, UD, woven)
- The equipment shall be capable of accommodating at least 20 different rolls of semi-finished materials so that preforms having minimum 20 fabric layers can be manufactured (minimum roll diameter = 200mm)
- It shall be possible to use different preform forming-tools (flat-profile, C-profile, T-profile) easily
- Individual temperature regulation for binder activation up to 250°C along the length
- Dosing system for injecting minimum amounts of reactive binder systems for chemical stitching (min. 4mg per injection point)
- Minimum density of injection points: $1/cm^2$
- Processing speed for preform manufacturing shall be up to 2 m/min
- A device for cutting of dry preform profiles of various lengths
- Process controlling over control computer
- Interface for real time input and output of all control parameters and possibility of external control programming (for example through DaisyLab or LabVIEW).

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Design-concepts of the preform production line	Report, CAD generic model	T0 + 4
D2	Detailed construction of the preform production line	Report, CAD detailed model	T0 + 10
D3	Build-up of the assembly and first preform trials	Report, Evaluation of the first trials	T0 + 15
D4	Optimization of the process to achieve the demonstrator geometry	Report	T0 + 17
D5	Production of demonstrator profiles (C-stringer) and evaluation	Report	T0 + 18

4. Topic value (€)

The total value of this work package shall not exceed:

€ 300.000

[three hundred thousand euro]

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

5. Remarks

Topic Description

CfP topic number	Title		
JTI-CS-2011-1-ECO-02-012	**Intelligent Load Power Management Rig Module**	**End date**	*T0 + 24 Months*
		Start date	*T0*

1. Topic Description

List of Acronyms:

AC:	Alternating Current
A/C:	Aircraft
CfP:	Call for Proposal
CMF:	Central Management Function
DC:	Direct Current
EDS:	Eco Design for Systems
E-ECS:	Electrical Environment Control System
EMA:	Electro-Mechanical Actuator
EPC:	Electrical Power Center
EPDS:	Electrical Power Distribution System
EPGDS:	Electrical Power Generation and Distribution System
ETB:	Electrical Test Bench
FPGA:	Field Programmable Gate Array
GA:	Generic Architecture
GCS:	Global Control System
HVDC:	High Voltage Direct Current
ICD:	Interface Control Document
I-LPM:	Intelligent Load Power Management
ITD:	Integrated Technology Demonstrator
JTI:	Joint Technology Initiative
PMF:	Power Management Function
POA:	Power Optimized Aircraft
PSD:	Power Switching Device
RCCB:	Remote Control C/B
VHDL:	VHSIC Hardware Description Language
TBD:	To Be Defined

BACKGROUND

Within the Eco-Design for Systems (EDS) ITD framework, the demonstration of the “ecolonomic” benefits for the all-electric and/or more-electric small a/c concept will include, as a first step, the validation of a/c optimization methodology, based on a set of numerical models and data constituting the virtual definition of the a/c vehicle systems architecture. The validation of these models and data will be obtained through model correlations with *ground tests* results on the basis of a Generic “Multi-Functional” Architecture (GA) common to all small a/c types (i.e., business jet, regional a/c and rotorcraft).

Test activities will be performed to validate the methodology and associated models to optimize complete a/c vehicle systems architecture for an all/more-electric aircraft. In addition, other main purpose of test activities will be the “real-life” evaluation of some selected innovative key electrical technologies for specific technological areas, such as generation, distribution, power network integration, power electronics and actuation systems, as derived from the definition of the EDS GA. More in detail, the electrical tests will try to capture both steady-state and dynamical behaviors of equipment, study in detail electrical transients, measure actual network quality and stability.

The tests will be performed on a ground Electrical Test Bench (ETB) partially representing the Generic Architecture as defined by the air-framers from the architecture down-selection.

To achieve the above objectives, the ETB will comprise electrical and electronic technologies for power generation, distribution and users' consumption. It will also present a level of modularity in order to:

- accept real and programmable loads,
- reconfigure distribution network and delta-voltage references,
- change components (e.g. from simulating device to representative one),
- change from business jet to regional aircraft or rotorcraft components,
- investigate different technologies (e.g., e-ECS).

Most of the tests are expected to be conducted on what will be the rig implementation of the Generic Architecture and will be common to the three small vehicle types (business jet, regional a/c and rotorcraft), while some specific tests will be added for the different vehicle types.

From the specific regional side, as an objective, the equipment to be used on the bench for the Regional configuration tests will be representative of a future all-electric regional a/c EPGDS architecture, thus also enabling a full validation of the Intelligent Load Power Management (I-LPM) concept.

The Electrical Test Bench will actually comprise, inter alia, an Electrical Power Center (EPC) and a rig central Global Control System (GCS).

The EPC is supposed to mainly include bus bars and commutation elements (mainly conventional contactors and RCCBs) to provide power supply to the attached loads while ensuring safety functions. Electronic control units are also foreseen to transfer data to control/command test bench system. Additionally, the EPC will be equipped with a software package (simulation tool done with Matlab-Simulink) able to pre-test all the EPC configurations by software before testing in real on the hardware and having the possibility to compare the simulation results and the measurements performed during the real test on hardware. This tool will also be able to simulate and programme switching logics and energy management algorithms (I-LPM) so as to automate the EPC.

On the other side, the rig GCS as well will be able to run test operations by offering emulation commands to the equipment under test with at least two modes of operation, one of which being a "scenario" mode through which a predefined time sequence is run.

SCOPE OF WORK

The objective of this call for proposal is the design, manufacturing, commissioning and validation of a separate integrated hardware module (extension of the EPC) fully interfaceable with the EPC and including advanced power switching components and electronic boards able to physically implement the I-LPM hardware and control logics.

Intelligent Load Power Management concept

Currently, any abnormal electrical condition (i.e., one generator missed), that results into an extra demand of electrical power, is addressed to the overload capacity of generators. Besides, shouldn't this features be enough to manage the peak power request, several loads may be totally shed as they are not flight or safe-landing essential. This policy is the so called "load management".

The trend that Clean-Sky JTI is investigating will make generators rated size higher and higher. This implies that no overload capacity can be taken into account in the design, as long as weight and volume are desired to stay within objective figures. Moreover, most essential loads change into electrical power consumers (electrical flight controls, brake, ice protections,...) therefore, they can't be easily shed. The way proposed to face this key steps towards new concept electrical network is an *"Intelligent" Load Power Management* (I-LPM).

By definition, I-LPM is an *advanced smart control* of aircraft electrical loads *optimizing weight, volume and consumption*, being able to *"smooth" extra power demands* due to power transients and/or to electrical failures (normally addressed to the generator overload capacity) by compensating them with a proper reduction of the power demand from those loads which are "non critical" for that specific flight phase or operating condition.

Its basic principle is to force global electrical power demand to decrease, even during an extra demand condition. The network voltage applied to some selected power consumers is chopped and it results in *power modulation* (not applicable to regulated constant power devices for which power management has to be managed by software signals).

But, unlike the conventional load management, the selected consumer, suffering the power decrease, is far from being shed, as the chopping is pushed just to a predefined extent. The shedding of loads suffering short circuit or unhealthy conditions (a peculiarity of conventional load management) still continues to be applied, and it may be regarded as a boundary condition of I-LPM.

Each load is connected to an Electrical Power Center (EPC) through a *Power Switching Device* (PSD),

- acting as an *ON-OFF switch* (contactor-like function),
- possessing *protection capability* (circuit-breaker-like function),
- performing *high-frequency switching* (voltage chopping function).

The PSD is a component which *plays a main role* in the electrical distribution and *whose switching sequence is driven by a programmable logic matching several control signals*. In particular, such a device is capable of *modulating the voltage to the load*, thus causing a power absorption Pi whose variation can be expressed as follows:

$$P_i^{min} \leq P_i \leq P_i^{nom}$$

So the management of overload capacity is then accomplished *at a distribution level* while the generators are going to be sized for the heaviest power demand which, thanks to the I-LPM policy, corresponds to the nominal one.

$$max\left[\sum_{i=1}^{N} P_i\right] = P^{nom}$$

The I-LPM *core controller (implementing the control logics)* allocates for the generic i-th load a power request that is function of several parameters, such as:

- *Load-peculiar parameters*:
  - deterministic and unchangeable (electrical, thermal, ... dynamics);
  - deterministic and function of the specific flight phase or operative mode (priority, critical state);
  - random (load health status, ...).
- *Network parameters*:
  - contemporaneity and utilization factors;
  - trend towards saturation of generators nominal capacity (di/dt).

The logical function accomplished by the controller can be summarized by the following mathematical relationship:

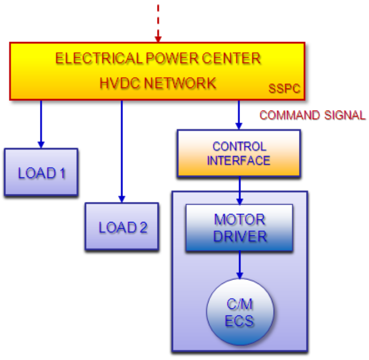
$$P_i = \mathfrak{F}(par_1, par_2, par_3, \ldots)$$

However, *I-LPM with voltage chopping can not apply to “constant power” consumers* (e.g., e-ECS motor), as it is not possible to modulate the power to those loads *by means of a chopped voltage only*.

In this case, there is the possibility to *use directly the functionalities of their already existing input converters* (e.g., the e-ECS motor driver) to operate a power consumption reduction, thus also *avoiding to duplicate functions and hardware*.

The power modulation is completely addressed to the load itself which receives from I-LPM core controller a *command signal* only.

The e-ECS motor dynamic load bank is a good candidate to be the “power-sink” from which the necessary power to support the transient electrical conditions can be taken, without modifying the power provision of critical loads. As a matter of fact, the power modulation to the e-ECS motor does not affect its well functioning unless its average value overcomes a predefined extent.



Example of e-ECS load bench control

Other Types of Loads

EMA load (equipped with a load antagonist): plays the role of an essential power consumer, whose power demand shall be completely satisfied at any case and without any downgrading.

Sharp dynamic load bench: plays the role of a sudden and not controlled power request, leading the global power demand closer and closed to generator capacity saturation.

Resistive load: it is representative of a not essential load that can be degraded in power by lowering the voltage at its input.

Power Management Function

There is a "direct dialog" between the Power Management Function (PMF) (i.e., the function accomplished by the control logics implemented in the I-LPM core controller) and the intelligent loads (e.g., e-ECS).

The PMF performs the following operations:

- Electrical balance forecast computation. Result can be OK or KO with a new request taken into account;
- Calculate power allocations (p , μ , 0) using power requests, priority rules and system status;
- Communicate to each load the allocated power, which either matches the requested power or is lower;
- Knows that a load has accepted an allocation when the load requests a power that is low enough to be granted by the PMF.

The loads perform the following operations:

- The loads evaluate their own power requirement;
- Define the evolution from their current point of operation to the desired point of operation;
- Request power in small steps up and down;
- Receive power allocations from PMF and reply;
- If the allocation is accepted, they reply by a request of the same value;
- Otherwise they reply by a request of a lower value or zero, and may turn themselves off.

Power Management and Central Management

The same dialogue used between the PMF and an intelligent load could be used between the rig *Central Management* (CM) function (which exchanges control data with the EPC) and an I-LPM chopper connected to a "dumb" load (e.g., pure resistive load), so that:

- *the I-LPM chopper would be the surrogate of a load and would add intelligence to the dumb load*, enabling the PMF to vary its point of operation;
- *Central Management function would talk to choppers I-LPM load control and to intelligent loads directly using the same language*;
- *PMF and CM function would share a common protocol* allowing both functions to talk to intelligent loads and I-LPM choppers.

In case of dumb resistive loads (e.g., thermal anti-ice elements), the PMF control logics result in driving signals for the PSDs (mainly by setting the duty cycle of the high-frequency voltage switching).

DESCRIPTION OF WORK

General Requirements

Given the above depicted scenario, the selected Candidate shall develop an hardware module (extension of the rig EPC) integrating advanced power switching components and electronic boards able to implement the I-LPM concept.

The module shall implement innovative control logics for an optimal sharing and allocation of the electrical energy among selected distribution loads. Such logics, coming from the matching of several control laws, are supposed to be actually implemented inside the associated electronic boards (micro-controllers or FPGA based), thus resulting in driving signals for the switching components which address the proper power modulation to the selected distribution loads.

The module shall be fully interfaced with the rig main Electrical Power Center and it shall be activated or deactivated in case of need depending on the specific test configuration. When activated, the module shall take full control on selected power loads to which I-LPM strategy will apply (no more than 3-4 load consumers). All the documentation needed for allowing the correct electrical, mechanical and control interfaces with the EPC and the rig GCS will be provided to the selected Candidate as an input at the early stage of the Project.

Intelligent Load Power Management Requirements

As an objective, on the ETB the verification activity of I-LPM functions and performances shall consist in applying the I-LPM control logics to some selected power consumers trying to keep the overall electrical loads within the nominal rate of generator, for each combination of loads in steady or temporary state. That mainly by:

- *Enforcement of priorities between power consumers*;
- *Controlled transfer of power without relying on generator overload capability*;
- *Cooperation with network active stabilization function*.

The possibility of monitoring the *generator current derivative* (providing a status on how it is nearing generator capacity saturation) will give the opportunity to verify the I-LPM concept and control logics.

I'g: it is the generator derivative current. The I-LPM strategy shall consider the I'g value with respect to given thresholds (function of flight condition set via remote terminal) in order to obtain an indication about generator saturation status and react appropriately, scheduling a suitable power allocation.

The I-LPM core controller shall derive and process the global rig Electrical Power Distribution System status and it shall appropriately react to any normal or abnormal condition and consequently drive the switching devices with an innovative control and modulation strategy, able to fulfill the management strategy objectives.

The power modulation addressed by the I-LPM core controller shall act on the *pure resistive loads* (i.e., variable power loads) by actually varying the voltage at their input stage so as to vary the real power absorbed by the loads. On the contrary, for the *fixed power loads* (i.e., motor loads like the e-ECS motor-compressor) the I-LPM core controller shall send the motor controller (i.e., inverter) a command signal only with the requested power degradation so that the actual power modulation will be actually performed by the motor driver itself.

The proposed I-LPM approach shall guarantee the robust system stability, defined as the possibility to reach a safe status against all incipient recognized (possibly critical) conditions; for this reason, the approach formalism shall require to describe any possible system status. Besides, the proposed strategy shall be customizable and expandable for different systems, e.g., obtained by adding new loads with different priorities or defining alternative control logics.

Finally, the PSDs innovative control technique shall guarantee fast and robust response to any power level variation requests, and enhanced controller performances, such as disturbance rejection and insensitivity to electrical system parameter uncertainties.

A preliminary software implementation of I-LPM strategy shall verify the effectiveness of the proposed approach. The I-LPM shall be implemented for a suitable multi-physics simulation environment, modelling both the equipments of interest (e.g. generator, e-ECS, PSDs and loads) and the control strategy in a formal framework. The possibility of an automatic or semi-automatic translation of the I-LPM strategy from the simulation environment to the electronic boards programming language (e.g. VHDL) will be particularly valuable for CfP evaluation.

Power Switching Devices Requirements

The I-LPM module shall integrate the power switching and protection devices for electrical power supply management according to the electrical scheme and with the corresponding ratings, as it will be provided in the detailed ICD documentation.

Each power switching device (PSD) device shall have an individual, independent protection so that no single failure may affect the protections of several lines.

Each PSD shall be open when its command does not receive any supply.

Each PSD shall present a voltage drop at its rated current so that the global voltage drop requirement is fulfilled.

The response time of each PSD during opening or closing operations shall not exceed TBD ms.

Each PSD shall be capable of providing its open/close information (status) through an open/close circuit separated from the main power.

Each PSD commuting a high DC voltage shall be equipped with a preload function.

The switching function shall be controlled both in duty cycle and switching frequency.

For the PSDs to be developed, the selected Candidate shall take into account:

- *the acceptable frequency values for the switching capacity* (at least 1 kHz to have a low ripple);
- *the caliber availabilities under HVDC supplying* (refer to equipment list document providing the power loads to which the control strategy shall apply, at least 50 A at 270 VDC);
- *the possibility for the I-LPM module to be digitally programmed in order to extend PSD functionalities.*

PSD shall be configured in three different modes: fuse (with digital remote reset), resetting (perform several attempts to close until the problem is solved), and reconfigurable, where the maximum load current is remote set.

- *the possibility to receive and react to alerts from the power loads,* e.g. if abnormal conditions occur in terms of current absorptions;
- *the possibility to put PSD modules in parallel*;
- any other improvement which could be interesting for this scope.

Environmental Requirements

The I-LPM module will be located in a laboratory room for functional tests. Therefore, the environmental requirements shall be limited to a compatibility of the I-LPM module with the laboratory environmental conditions. Anyway, a detailed Interface Control Document (ICD) will be provided to the selected Candidate detailing all the environmental conditions that the module shall comply with.

As an example, as the equipment shall not be installed on the aircraft, the temperature requirement shall be taken into account just for the selection of the appropriate technologies and components and not for qualification. The range to be considered for the selection shall be 15 ÷ 40 °C

Electrical Power Requirements

The rig EPC will provide DC power when supplied with 270 VDC input power, whose normal and abnormal characteristics in steady-state and transient are listed in MIL-STD 704F reference power quality standard.

The I-LPM module shall not integrate HVDC bus bars (they will be integrated inside the rig EPC), while the system shall include wires to connect the various inputs and outputs to/from the EPC, according to the detailed electrical scheme contained with the ICD document to be provided to the selected Candidate.

All the connections shall support the rated voltage as specified in MIL-STD 704F. All the connections shall be isolated from the ground and between them.

Control and Monitoring Requirements

The I-LPM module shall integrate a software able to monitor the overall status, to detect any failure occurring on the bus bars and on each contactor or protection, to tune protections. It shall be possible to perform this task via remote terminals, therefore the I-LPM module shall be equipped with a communication gate towards test Rig GCS and the EPC.

Operational Requirements

- The I-LPM module 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 shall be greater than 10 000 operating hours;
- 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

- The I-LPM module shall comply with European and French standards related to electrical power installations, and low voltage electrical installations;
- The I-LPM module 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 I-LPM module configuration is.

  Those two requirements are to be specified in the ICD.
- The I-LPM module shall as far as possible comply with DO 254 for its hardware components.

Other Criteria to meet

The system shall be as compact as possible but it may be handle for maintenance and manual operations. The EPC will 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 (e.g., 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. It shall be designed to the minimum weight that assures all performances required.

The I-LPM module shall be air-forced cooled by means of an internal fan. Should PSDs and/or other smart power switches require a more effective heat dissipation, a liquid cooling capability shall be taken into account according to the ETB provisions as detailed in the ICD documentation.

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

Input Documentation

The following inputs will be distributed to the selected Candidate at the early stage of the Project:

- Rig Electrical Power Distribution System architecture (electrical scheme of EPC);
- Interface Control Document for environmental conditions to be met;
- Interface Control Document for electrical, mechanical and cooling connections with the EPC and the overall ETB;
- Control logics for the I-LPM core controller implementation (in the form of logical equations);
- Equipment List, describing in details the characteristics of the power consumers to which the I-

LPM policy shall apply.

WORK-FLOW

The Candidate activity shall include:

- Detailed study of the solution;
- Manufacture of the system;
- Integration and commissioning;
- Validation and optimization of the system.

The selected Candidate shall provide technical documentation (reports) for each of the major activities. In particular, a final report with the results of validation phase shall include possibilities for further investigations and optimizations of the system, either regarding the core controller and the switching components.
The Candidate shall include in the proposal a validation matrix and plan for the development of the module. In particular, the candidate shall propose a set of significant test cases in order to step by step validate the control functions and performances of the developed components inside the module.
The Candidate shall include in the proposal a risk matrix with associated risk severities, probabilities of occurrence and mitigation aspects.
The system should be innovative, either by the solution (control technique), or by technology, materials. Fields to be explored could be:

- Innovative other solid-state-based power switching components capable of performing high frequency voltage modulation at requested rating;
- Modular architecture, possibility to easily change the switching components, 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 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 step in the current state of the art.

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

The Candidate organization shall have:

- expertise in electrical system design (power generation, power conversion, power distribution network, power consumer),
- a well recognized experience in advanced control system techniques,
- knowledge of Industrial/Aeronautical field constraints and procedures,
- experience in system simulation methods and modeling,
- good practice in English language.

The Candidate shall preferably rely on a background in control and supervision of complex systems. Experience in laboratory or industrial test benches design, manufacture and installation will be an asset.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	PDR	Preliminary Design Review and associated deliverables	T0 + 6
D2	CDR	Critical Design Review and associated deliverables	T0 + 9
D3	Installation and commissioning	Delivery of the complete system with its associated documentation, installation and commissioning on site	T0 + 16
D4	Validation and optimization	Validation test report and optimization issues	T0 + 18
D5	Support	Further to the commissioning on site, the CfP Supplier shall	T0 + 24

		support the rig operations to correct potential faults during this probation period.	

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 Clean-Sky program.

5. Remarks

Clean Sky – Green Regional Aircraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	**8**	**3.400.000**	**2.550.000**
JTI-CS-GRA-01	*Area-01 - Low weight configurations*		**750.000**	
JTI-CS-2011-3-GRA-01-039	Hybrid laminates Industrialization for a/c nose fuselage/cockpit		300.000	
JTI-CS-2011-3-GRA-01-040	Nose Fuselage/Cockpit dynamic characterization for internal noise attenuation		200.000	
JTI-CS-2011-3-GRA-01-041	Optimal tooling system for design for large composite parts		250.000	
JTI-CS-GRA-02	*Area-02 - Low noise configurations*		**2.150.000**	
JTI-CS-2011-3-GRA-02-017	Advanced low noise Main and Nose Landing Gears for Regional Aircraft -Trade off concept studies		2.000.000	
JTI-CS-2011-3-GRA-02-018	Low Noise Devices aeroacoustics numerical Simulation		150.000	
JTI-CS-GRA-03	*Area-03 - All electric aircraft*		**500.000**	
JTI-CS-2011-3-GRA-03-006	Development and manufacturing of Programmable Electrical Loads and advanced Power Supply		100.000	
JTI-CS-2011-3-GRA-03-007	Improvement of numerical models for JTI/GRA Shared Simulation Environment		150.000	
JTI-CS-2011-3-GRA-03-008	Control Console and Electrical Power Center for In-Flight Demo		250.000	
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-2011-3-GRA-01-039	**Hybrid laminates Industrialization for a/c nose fuselage / cockpit**	**Start date**	*T0*
		End date	*T0+15*

1. Topic Description

***Short description**:*

The subject of this CfP is to produce a set of curved panels representative of the structure that conforms the nose fuselage stiffened skin with hybrid configuration to anticipate manufacturing problems for the integration of twisted stringers of different shape section. These panels will be used to consolidate some test results highlighted on flat specimens..

1.1 Introduction

This work is allocated inside the WP 1.3.7 & 1.4.1 which is devoted to consolidate the industrial alternative to be proposed for demonstrator manufacturing.

1.2 Reference documents

None

1.3 Scope of work :

The job to be done must be based on a quick prototyping of a curved panel with stiffeners with architecture representative of the stiffened skin that conforms the nose fuselage. Skin lay-up and material must reproduce the selected one for flat panels manufactured within the same Wp 1.3.7.

One manufactured with enough quality, some tenting will be carried on to consolidate or complement data base configured up on coupons and flat panels. Some of the testing deals with acoustic characterization therefore the size must be compatible with the rig used for this purpose. For quotation (min of 2x1.5 m2 should be considered). It is foreseen that, as far as possible, the specimen will be used for low, medium energy impact & antierosion testing through the extract of structural portion or directly on the whole specimen. For this correspondent request documentation will be procured by the CfP launcher.

1.3.1 – Specimen Design

Although it is preferable that the curvature of the panel corresponds to the nose fuselage (i.e double curvature, noting the quick prototyping demand, a single curvature might be also possible. In this context, exiting tooling could be partially refurbished to be adapted for the purpose of this CfP. It must be understood that although different in some extent, the curvature and stringer pitch must be within same order of magnitude to enable “read-across” results.

The location and stringers configuration will be decided depending on the final dimensions of the curved panel being proposed. Maximum stringer twist onto the proposed curvature should be tackle for quotation.

All design details to be implemented in the manufacturing trials will be supplied by the CfP launcher through CATIA models and specifications. The applicant will integrate all the agreed details aspects generally forwarded the demonstrator into a prototype panel. This will end up with a CATIA overall design model ready for manufacturing.

The number of stringers to be integrated is not fully decided but for quotation purpose no more than three should be considered.

From the point of view of skin configuration, two different lay-up with external / internal metallic mesh for electromagnetic protection and electrical conductivity improvement shall be accounted.

1.3.2 – Tooling

Following the design phase, the applicant shall design the tooling or refurbish existing one to enable representativety of final structure geometry and cure cycle process. It is extremely convenient for the production process to be close enough to the foreseen one being followed on the demonstrator. Special care has to be taken to minimize, and if possible avoid, spring-back of manufactured stiffened panels.

Functionality (i.e vacuum check or tolerances validation) of the tooling must be verified in advance to the manufacturing trial.

1.3.2 – Panel Manufacturing

To enable assessment of manufacturing variability process a minimum of two panels of each configuration will be produced. It is expected that 4 trials should be enough to come with the two required specimens.

1.3.2.1 - Inspection

Production quality will be checked through the corresponding non destructive inspection. The results of such inspection will be assessed into the appropriate report. Quality repairs proposal will be complementally documented.

In addition to the porosity, delamination and other similar kind of defects, dimensional inspection of geometry and tolerances (thicknesses, stringer position or surface distortion coming from spring back) must be carried out.

1.3.2 – Panel Testing

With the main purpose to consolidate / complement results obtained from coupons & flat panels, a set of testing will be carried out on the manufactured panels and/or on portions extracted from them.

Currently abrasion, low or medium energy impact and acoustic test are foreseen. Due to the curvature, mechanical test are not suitable of being performed from coupons extracted directly from panels although some basic ones might be decided on flat wise travellers, if it is judged appropriate.

Compatibility with existing and advanced surface protections extracted from parallel research must be assessed.

1.4 Requirements :
Spring back prediction must be done in conjunction with CfP launcher to assure minimal distortion. This might be based on previous experience or, if necessary, on simulation with FEM or similar tool.

1.7 Schedule, milestones and deliverables:

a) Design (T0+2)
b) Tooling manufacturing (T0+08)
c) Specimen manufacturing & inspection (T0+12)
d) Testing & reporting (T0+15)

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

Experience in composite design, manufacturing and NDT
Experience in tooling design
Experience in CFRP laminates testing

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Design Models	CATIA	T0+02
D2	Tooling Models	CATIA	T0+04
D3	Tooling Manufacturing	Hardware	T0+08
D4	Specimen Manufacturing + Inspection	Hardware	T0+12
D5	Manufacturing report	Document	T0+13
D6	Test results	Document	T0+14
D7	Conclusion & Recommendations	Document	T0+15

4. Topic value (K€)

The total value of the proposed package is

300.000,00€

[three hundred thousand Euro]

NOTE: The funding to be from 50 to 75% of this maximum budget value. The total value of the activity is composed of manpower, equipment and all expenses associated with the task.

5. Remarks

The meetings for project monitoring will be held at Topic Manager installations premises. It is foreseen a meeting every three months.

Experience on the required subject must be referred by the applicant

Clean Sky Joint Undertaking
JTI-CS-2011-3-GRA-01-040

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-GRA-01-040	**Nose Fuselage/Cockpit dynamic characterization for internal noise attenuation**	**Start date**	*T0*
		End date	*T0+15*

1. Topic Description

***Short description**:*
The subject of this CfP is to evaluate by means of numerical models the acoustic performance of a CFRP nose fuselage in relation to a conventional metallic baseline configuration.

1.1 Introduction

This work is allocated inside the WP 1.4 which is devoted to validate through FEM the technologies and architectural concepts foreseen being used within demonstrator.

1.2 Reference documents

None

1.3 Scope of work :

The objective of this topic deals with the aspects described into the following points:

a) Development of a basic numerical model suitable of estimating noise radiated by the nose fuselage into the cockpit in the frequency range [0,400] Hz. The model will integrate a representation of the nose fuselage structure and the cockpit acoustic space. Fuselage vibration and cockpit acoustic field will be assumed to be coupled, so that simultaneous solving of the structural and acoustic problems is required.

b) Two different variants of the basic model will be refined for the purpose of the research based on existing FEM used for strength check-stress, these will correspond to:

- Reference metallic construction
- Hybrid fuselage with multifunctional laminates and advanced architecture.

The differences between both structures will include different material composition and material properties, different thickness distribution, and different frame and stringer spacing among other design aspects.

c) The inputs shall consist of:

- CATIA mock-up of the structure
- Baseline FEM´s used for check-stress
- Set of basic structural properties for those materials that constitute the primary structure. As far as possible, any other that can be considered essential to carry the job once identified by the applicant, will be managed as an input by the CFP launcher. Other integrated laminate characteristics such as overall density, stiffness, damping etc., adapted to the refined model will be derived by the applicant up on the base of an acceptability provided by the CFP launcher.
- Set of structural and acoustic loads.

d) Boundary conditions of nose fuselage (cockpit) at the interface with the rest of forward fuselage shall be representatively simulated. For this CfP launcher will provide maximum cooperation.

e) Among other aspects that might help to the analysis, the job to be done will account for:

- A comparison of structural modal bases up to 400 Hz. Low frequency modes will be individually compared for the two configurations. Higher frequency modes (no individual comparison is possible) will be compared in terms of modal density as function of frequency bands.

- A comparison of Frequency Response Functions relating structural response and structural excitation using different point forces.

- A comparison of averaged Frequency Response Functions relating acoustic response for various locations in the cockpit and structural excitation using different point forces.

- A comparison of averaged acoustic levels for various locations in the cockpit corresponding to a set of acoustic point sources located in the exterior of the nose fuselage.

- The developed models will be used for determining main contributions to interior noise in terms of modes and areas (i.e windows, floor etc). This analysis has to be performed using the following envisaged methods:

1) Modal-based

2) Topology-based

Modal-based methods are well suited for low frequencies where dynamic response is dominated by relatively few, easily recognizable global modes.

A topology-based method makes possible comparing different states with very different modal bases. Two different approaches could be considered for this topology-based CA:

a) Post-processing of a modal-based solution using the existing coupled vibroacoustic model. Grouping of different structural modes will be done according to which parts of the structure present higher structural response.

b) Masking/windowing using a forced-response solution. The acoustic radiation of selected areas of the fuselage will be alternatively activated/deactivated for determining acoustic response at one or more locations.

1.5 Requirements :

The simulation method and software package used to run the models shall be described. Expected modelling approach will be of FEM/FEM for the structural and acoustic problems. Alternative approaches may be considered if properly justified.

1.7 Schedule, milestones and deliverables:

e) Evaluation of available existing FEM´s details (T0+2)
f) Refinement of model used for reference for vibroacoustic simulation (T0+04)
g) Refinement of hybrid composite model for vibroacoustic simulation (T0+06)
h) Preliminary comparison of vibroacoustic results and sensitivity analysis for different excitation sources (T0+9)
i) Acoustic assessment of both structural cockpit designs (T0+12)
j) Detailed description of simulation models including inputs files to run the simulation. (T0+15)

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

Experience in simulation of coupled vibroacoustic problems.
Use of commercial software.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Structural Models – Conformity	Data reception of FEM available	T0+02
D2	Vibroacoustic Model – Baseline	Refined Model	T0+04
D3	Vibroacoustic Model – Composite	Refined Model	T0+06
D4	Technical Report Preliminary	Document	T0+09
D5	Technical Report Final	Document	T0+12
D6	Model electronic files & user guidelines	Electronic files & Document	T0+15

4. Topic value (K€)

The total value of the proposed package, is

200.000,00€

[two hundred thousand Euro]

NOTE: The funding to be from 50 to 75% of this maximum budget value. The total value of the activity is composed of manpower, equipment and all expenses associated with the task.

5. Remarks

The meetings for project monitoring will be held at Topic Manager installations premises. It is foreseen a meeting every three months.

Experience on the required subject must be referred by the applicant.

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-GRA-01-041	Optimal tooling system design for large composite parts	**End date**	$T_0 + 12$
		Start date	T_0

1. Topic Description

1.1 – Scope of work

The contractor shall define all the necessary steps to complete the design and manufacture of a large tool for a composite complex structural part (representative of a fuselage stiffened section / panel with cocured stiffeners- typically 2-3m length to be defined by Topic Manager).

Further to the design and manufacture of the tool, the composite structural part (fuselage stiffened section / panel) must also be manufactured using above mentioned tool. By comparing the "as designed" and "as manufactured" composite part, the correctness of the designed and manufactured tool can be proved and validated. The geometrical complexity of the final manufactured composite part, should be a part with double curvature and co-cured stiffening elements (typical cross sections "Ω","Z","T"). The manufacturing of the final part shall be accomplished at Topic Manager premises under the appropriate guidance / consultancy of the contractor. Topic Manager undertakes responsibility to provide the personnel as well as the appropriate equipment / row materials for completing the task.

The tool design shall take into account the following requirements:

- Capability for achieving high accuracy typical of aerospace components
- High Rigidity of tool
- Ability to withstand high temperatures / pressures without ruining the part under construction (Typical autoclave cycle conditions: 180°C & 7 bar pressure)
- Matching coefficient of the tool to the composite part material (typically carbon fiber epoxy parts → Low CTE)
- Durable (last for many cycles – typically 500 autoclave cycles, ability to withstand normal wear & tear)
- Minimal weight resulting in minimal thermal mass to allow fast heating / cooling cycles
- Provision for easy transportation / handling in a standard composites facility environment (i.e. fork lifts, cranes, wheels etc)
- Provision for easy access in areas of the tool difficult to reach (i.e. centre of the tool)
- Integration of accessories for easy demoulding of part from tool (i.e. air-pressure assisted, removable parts in the tool etc)

Optionally the following requirements are preferable:

- Capabilities to do easy modifications on the tool
- Capabilities to do easy repairs on the tool

The tool construction should be metallic with a material complying with the above requirements.

The tool should also contain all necessary parts / configuration to allow for the co-curing of stiffener elements in the panels (in various configurations: typical cross sections "Ω","Z","T")

The tool should comply with all modern lay-up (manual or automated) configuration techniques for pre-preg autoclave curing (integration of necessary accessories for vacuum/ laser projection equipment / silicone vacuum bagging etc)

1.2 – Reference documents

- Aerospace Engineering and Manufacturing, 10 Nov. 2010
- Zhu, Q., Geubelle, P. H., Li, M., Tucker, C. L., III, "Dimensional accuracy of thermoset composites: simulation of process-induced residual stresses", Journal of Composites Materials, vol. 35, no. 24, pp 2171-2205, 2001
- Manufacturing Engineering, April 2010 Vol. 144 No. 4

1.3 – Introduction

1.3.1 - Background

An important aspect of composite fabrication for aircraft parts is the capability to manufacture increasingly larger components. As production scales up, more-efficient manufacturing becomes increasingly important. An important step to that efficiency is tooling for composites.

A factor that has been clearly identified as playing a key role in process induced stress development and deformations in fiber reinforced composite parts during autoclave curing is the effect of tooling. The thermal and mechanical properties of the tooling and the mechanical interaction between composite part and tooling will influence the curing process; the effect is complicated by geometrical features of the part. The mismatch between coefficients of thermal expansion (CTE) of the composite part and tooling has been identified as an important contributor to process induced residual stresses developed during autoclave manufacturing

The factors that are responsible for composite part deformation (warpage and spring-in / out) need to be evaluated in order to identify the optimum values that would ensure the best geometrical and dimensional stability of the final part.

1.3.2 – Interfaces to ITD

The work is integrated within the WP 1.5.2 & 1.6.2 activities since one of its main objectives is the design and fabrication of a stiffened section / panel representative for fuselage for the ground demonstrator

1.4 - Activity Description

The final composite part configuration will be provided by Topic Manager (CAD models / layup configuration will be provided).

The contractor is responsible for the following tasks:

T1. The definition of the tooling basic configuration for the production of the final composite part by detailed identification of the criteria for tool configuration selection.. This includes:

- Backing structure design (typical eggcrate / frame type)
- Tool face design (including all necessary details typically used in modern lay-up configuration techniques for pre-preg autoclave curing
- Integration of accessories (secondary tools: metallic or elastomeric / pressure pads etc.) for co-curing of stiffening elements

The backing structure should be connected with the tool face by such means that the thermal deformations from the backing structure are not transferred to the corresponing tool face. Also provision for minor adjastments of the tool face in relation to the backing structure should be available.

T2. Simulation of final composite part springback by appropriate methodologies taking into account the forseen curing conditions in autoclave and part configuration / layup (i.e. FEM)

T3. Simulation of tooling thermal behaviour and adaptation of final tool face design based on part springback and tooling thermal simulation, in order to minimise geometrical descrepancies between the "as designed" / "as manufactured" final composite part.

T5. Manufacturing of tool structure (backing structure and tool face)

T6. Manufacturing of final composite part and validation of final part springback by comparisons with simulated results. The final part manufacture shall be performed at Topic Manager premises under the guidance / consultation of the contractor. All necessary materials / equipment / personel will be provided by Topic Manager (carbon fiber / layup materials, laser projection / autoclave equipment etc). Final part validation should also include quality features of the part (i.e. resin reach areas, non conforming areas etc) and corrective actions that should be applied in order to fix the undesired effects.

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

Expertise in tooling design and manufacturing (multi-part tooling) for aerospace quality composite parts.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Tool basic configuration / design	Definition of tool basic elements (backing structure / tool face, accessories for lay-up assistance, accessories for inserts integration). Identification of criteria for tool configuration selection	T0 + 2
D2	Simulation of final composite part springback	Simulation of composite part thermal / lay-up configuration induced deformations	T0 + 4
D3	Simulation of tooling thermal behaviour and adaptation of final tool face design	Final tool design configuration based on composite part & tool thermal / lay-up configuration deformations	T0 + 5
D4	Manufacturing of tool structure	Tool structure manufacture	T0 + 9
D5	Manufacturing of final composite part	Composite part manufacture at Topic Manager premises under the contractor consultation	T0 + 11
D6	Validation of tool final design	Comparisons between final manufactured composite part and "as designed" composite part dimensions and tolerances. Conclusions on final tool design.	T0 + 12

4. Topic value (K€)

The total value of the proposed package, is

250.000,00€

[two hundred fifty thousand Euro]

NOTE: The funding to be from 50 to 75% of this maximum budget value. The total value of the activity is composed of manpower, equipment and all expenses associated with the task.

5. Remarks

During the period allocated for the CfP, it is possible that additional information / requirements are given to the contractor. The contractor shall therefore adjust accordingly and embody the given information / requirements, prior to delivery of final product.

Topic Description

CfP topic number	Title		
JTI-CS-2011-1-GRA-02-017	Advanced low noise Main and Nose Landing Gears for Regional Aircraft -Trade off concept studies, large-scale mock-ups design manufacturing & WT testing.	End date Start date	1/1/2012 31/12/2013

1. Topic description

Introduction
The required work will be the identification and evaluation of low noise devices for aircraft main and nose landing gear (MLG and NLG). The applicant will identify a number of solutions for MLG and NLG noise reduction; the solutions have to be evaluated and compared by using CFD/literature/applicant previous expertise and have to be properly designed for application to a Turboprop baseline landing gear provided by the CfP proposer. After a first screening the most promising solutions have to be tested in an aero acoustic wind tunnel and evaluated with respect to noise impact for both Main and Nose landing gear.

A number of solutions will be suggested by the CfP proposers, additional solutions have to be proposed by the applicant, all the solutions have to be properly designed for installation on the actual Landing Gear provided by the CfP proposers and mechanical feasibility, integration has to be checked together with the CfP proposers.

Abbreviations and Definitions
A/C *Aircraft*
CfP *Call for proposal*
MLG *Main landing gear*
NLG *Nose landing gear*
WTT *Wind tunnel test*

Technical Information

The reference landing gears is a Turboprop Aircraft landing gear similar to the sketches reported in the figures 1 and 2. In figure 1 is reported as reference a representation of expected full size reference MLG geometry and in figure 2 a reference representation of expected full size landing gear geometry. The following solutions have been identified as mandatory solutions to be analysed:
- Landing gear fairing
- Landing gear perforated fairing
- Air curtain concept
- Liners

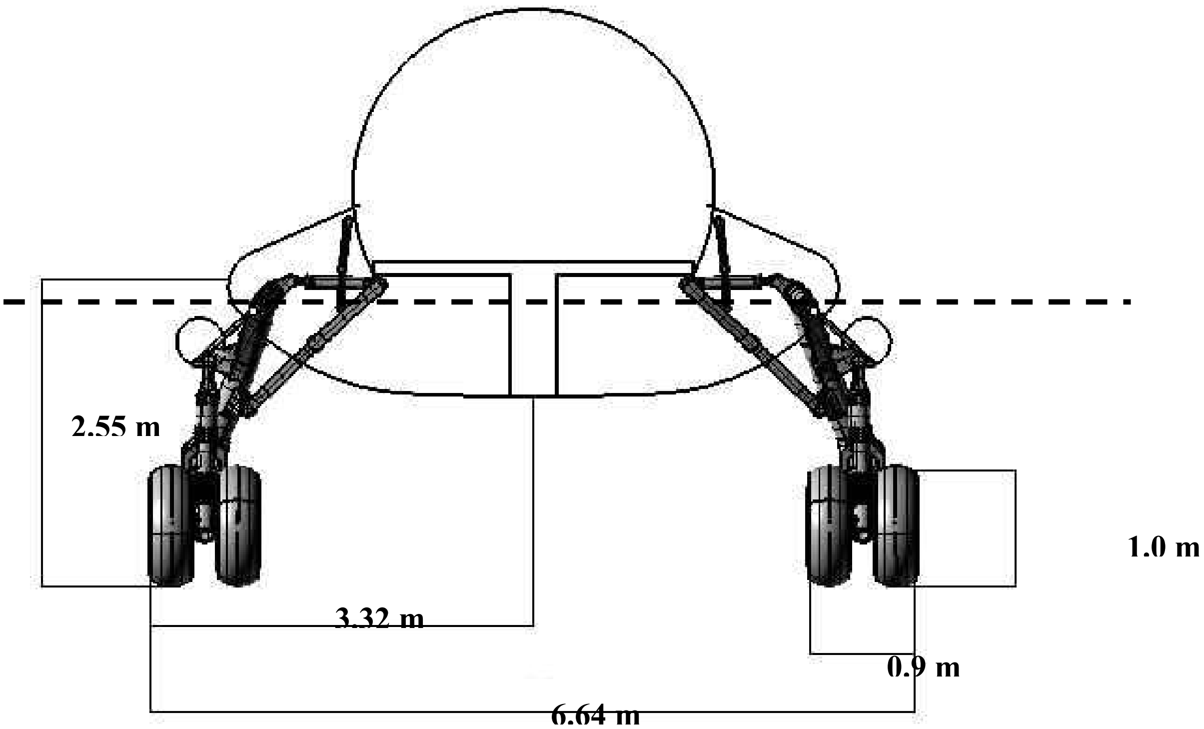


Figure 1: Expected full scale MLG reference geometry

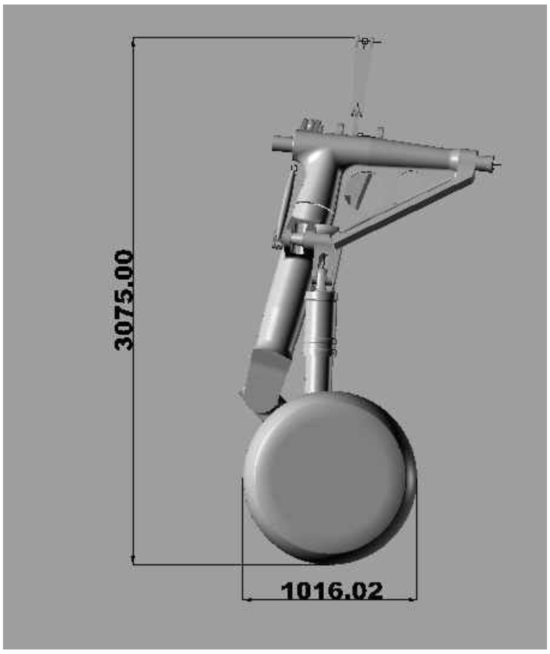


Figure 2: Expected full scale NLG reference geometry

These solutions have to be customized to the reference MLG and NLG with respect to mechanical integration (CfP proposers approval for the selected solution is required). The applicant has to suggest alternative solution and has to compare the different solutions with respect to noise reduction, mechanical complexity and weight. The new solutions and procedures used for the noise evaluation of the different concepts have to be described in the proposal.

In a second phase, a minimum of five concepts for each landing gear geometry (MLG and NLG) have to be tested in wind tunnel together with the baseline configuration for noise evaluation.

The wind tunnel models has to be a 1:2 scaled model of the geometries reported in figures 1 and 2 (therefore expected test articles size will be about 3.32 m X 1.27 m for the MLG and about .5 m X 1.5 m for the NLG), the wind tunnel bay and doors will be included in the model but the upper part of the fuselage will not be simulated . The wind tunnel model will include relevant noisy details such as cabling (a dressed model has to be used). Test speed has to be 40 and 60 m/s.

The following work-plan has to be followed by the applicant:

WP1: Main landing Gear Studies
Task 1.1: Identification and preliminary evaluation of Low noise solutions for MLG
Task 1.2: Specific design of MLG low noise solutions
Task 1.3: Theoretical evaluation of low noise solutions and down selection for main landing gear
Task 1.4:MLG WTT of selected solutions
Task 1.5: Conclusions and WTT analysis

WP2: Main landing Gear Studies
Task 2.1: Identification and preliminary evaluation of Low noise solutions for NLG
Task 2.2: Specific design of NLG low noise solution
Task 2.3: Theoretical evaluation of low noise solutions and down selection for nose landing gear
Task 2.4: NLG WTT of selected solutions
Task 2.5: Conclusions and WTT analysis

Required HW/SW description

In the proposal the applicant has to provide relevant information (including background noise level, flow quality, test section size and proposed model mounting solution, …) concerning the wind tunnel that will be used for the aeroacustics wind tunnel tests. The wind tunnel has to be an aeroacustic wind tunnel, instrumentation set up has to be provided (noise beam forming is required) and previous relevant expertise has to be demonstrated.

Reporting

In addition to the major deliverable reports a monthly progress report has to be prepared by the applicants in correspondence of each planned progress meeting.

Schedule: Meeting and review milestones

Time schedule has to be provided by the applicants in the proposal but the following key dates have to be respected:

June 2012: Identification of Low Noise concepts to be tested (deliverables D1)
June 2013: Wind tunnel test and data analysis completion (deliverable D9)

Progress report has to be provided monthly.
CfP proposers personnel has to be allowed to participate to Wind tunnel test campaign.

WP1: Mail Landing Gear Studies

Task 1.1: Identification and preliminary evaluation of Low noise solutions for MLG

Work description
In this WP the applicant has to propose concepts for landing gear noise reduction and has to show, by using mainly literature and applicant expertise, advantages and draw-back of each concept. In

addition the applicant will analyze additional concept proposed by the CfP proposers. The most promising concepts will be selected in cooperation with the GRA members.

Inputs:
Actual landing gear and bay detailed design (CAD files)
Alternative Low-Noise concept proposed by CfP proposer

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D1.1	Identification of Low Noise solution	Report describing LN MLG solutions	

Task 1.2: Specific design of MLG low noise solution
Work description
For the concepts identified in WP1 a detailed design will be performed and implementation of the concept on the actual test article will be performed. CAD files and report describing the design process will be provided by the applicant. A strict relationship with the CfP proposers is necessary and mandatory in this phase to assure that proposed concepts can be fitted in the actual aircraft.

Inputs:
None

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D1.2	Specific design of NLG solutions	Report and CAD files describing MLG LN solution design	

Task 1.3: Theoretical evaluation of low noise solutions and down selection for MLG
Work description
An evaluation of expected noise improvements will be performed by the applicant by using both literature, numerical analysis and applicant expertise. Since at this stage detailed CAD description of each concept defined in WP2 will be available a more accurate analysis with respect to the one performed in WP1 will be required. In the proposal the applicant has to illustrate the means that he plan to use for this evaluation (CFD, CAA, …). The most promising concept will be identified in cooperation with the CfP proposers and selected for the wind tunnel evaluation.

A selected number of concept will be analyzed by using CFD/CAA at wind tunnel and flight Reynolds number and scale by providing results in terms of third-octave band SPL noise spectra and power spectral densities at agreed locations. The objectives will be to compare numerical results with experimental data and to extrapolate results at actual scale at actual flight conditions.

Inputs:
Task 1.2

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D1.3	Preliminary evaluation of selected solution	Quantitative evaluation of expected noise improvements of each LN solution and selection of solutions to be tested in wind tunnel	
D1.4	CFD/CAA analysis of baseline and some selected low-noise concepts	CFD/CAA analysis of baseline and some selected Low-noise device to evaluate noise improvement, perform comparisons with wind tunnel test and evaluate noise improvement at actual flight conditions	

Task1.4: MLG WTT of selected solutions
Work description
1:2 scale Landing gear test article will be designed and built. Aeroacustic Wind tunnel tests will be performed to evaluate the noise reduction of each concept (baseline clean landing gear and landing gear with Low noise devices have to be tested). The applicant has to provide in the proposal characteristics of the wind tunnel, available instrumentation and description of previous expertise and a tentative test matrix. Previous expertise in aeroacustic wind tunnel test will be used for the proposal evaluation.

A lower surface and lateral surface microphone arrays have to be used for noise source identification by using the Beamforming techniques. Both Planar and 3D beamforming techniques have to be performed.

Inputs:
None

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D1.5	WTT requirements	Test matrix, WTT set-up, instrumentation.	
D1.6	WT model requirements	Report with test article requirements	
D1.7	WT model design	Report with wind tunnel test mechanical design	
D1.8	WT model provision	Test article provision	

Task 1.5: Conclusions and WTT analysis
Work description
Test report including draft and corrected wind tunnel data values has to be provided. The test report must include critical analysis of results and suggestion of most promising concepts.

A final report will be also issued containing a summary of main project results and also a critical comparison between WP4 experimental results and WP3 numerical results.

Inputs:
Task 1.1 to task 1.4

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D1.9	Test report	Test report including: EPNDB measurement results …	
D1.10	Final report	Project summary, numerical/experimental results, extrapolation to flight	

WP2: Nose Landing Gear Studies

Task 2.1: Identification and preliminary evaluation of Low noise solutions for NLG

Work description
In this WP the applicant has to propose some concept for landing gear noise reduction and has to show, by using mainly both literature and applicant expertise, advantages and draw-back of each

concept. In addition the applicant will analyze additional concept proposed by the CfP proposers. The most promising concepts will be selected in cooperation with the GRA members.

Inputs:
Actual landing gear and bay detailed design (CAD files)
Alternative Low-Noise concept proposed by CfP proposer

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D2.1	Identification of Low Noise solution	Report describing LN NLG solutions	

Task 2.2: Specific design of NLG low noise solution
Work description
For the concepts identified in WP1 a detailed design will be performed and implementation of the concept on the actual test article will be performed. CAD files and report describing the design process will be provided by the applicant. A strict relationship with the CfP proposers is necessary and mandatory in this phase to assure that proposed concepts can be fitted in the actual aircraft.

Inputs:
None

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D2.2	Specific design of NLG solutions	Report and CAD files describing NLG LN solution design	

Task 2.3: Theoretical evaluation of low noise solutions and down selection for NLG
Work description
An evaluation of expected noise improvements will be performed by the applicant by using both literature, numerical analysis and applicant expertise. Since at this stage detailed CAD description of each concept defined in WP2 will be available a more accurate analysis with respect to the one performed in WP1 will be required. In the proposal the applicant has to illustrate the means that he plan to use for this evaluation (CFD, CAA, …). The most promising concept will be identified in cooperation with the CfP proposers and selected for the wind tunnel evaluation.

A selected number of concept will be analyzed by using CFD/CAA at wind tunnel and flight Reynolds number and scale by providing results in terms of third-octave band SPL noise spectra and power spectral densities at agreed locations. The objectives will be to compare numerical results with experimental data and to extrapolate results at actual scale at actual flight conditions.

Inputs:
Task 2.2

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D2.3	Preliminary evaluation of selected solution	Quantitative evaluation of expected noise improvements of each LN solution and selection of solutions to be tested in wind tunnel	
D2.4	CFD/CAA analysis of baseline and some selected low-noise concepts	CFD/CAA analysis of baseline and some selected Low-noise device to evaluate noise improvement, perform comparisons with wind tunnel test and evaluate noise improvement at actual flight conditions	

Task2.4: NLG WTT of selected solutions
Work description
1:2 scale Landing gear test article will be designed and built. The NLG model should include also wheel and the landing gear bay and door, but fuselage will not be tested. The nose landing gear model has to be modular so that both the complete configuration (wheel, strut, bay and door) and a simplified configuration (only wheel and strut) can be tested. The model has to be provided to GRA members for additional tests in a different wind tunnel if required.

Aeroacustic Wind tunnel tests will be performed to evaluate the noise reduction of each concept (baseline clean landing gear and landing gear with Low noise devices have to be tested). The applicant has to provide in the proposal characteristics of the wind tunnel, available instrumentation and description of previous expertise and a tentative test matrix. Previous expertise in aeroacustic wind tunnel test will be used for the proposal evaluation.

A lower surface and lateral surface microphone arrays have to be used for noise source identification by using the Beamforming techniques. Both Planar and 3D beamforming techniques have to be performed.

Inputs:
None

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D2.5	WTT requirements	Test matrix, WTT set-up, instrumentation.	
D2.6	WT model requirements	Report with test article requirements	
D2.7	WT model design	Report with wind tunnel test mechanical design	
D2.8	WT model provision	Test article provision	

Task 2.5: Conclusions and WTT analysis
Work description
Test report including draft and corrected wind tunnel data values has to be provided. The test report must include critical analysis of results and suggestion of most promising concepts.

A final report will be also issued containing a summary of main project results and also a critical comparison between WP4 experimental results and WP3 numerical results.

Inputs:
Task 2.1 to task 2.4

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D2.9	Test report	Test report including: EPNDB measurement results …	
D2.10	Final report	Project summary, numerical/experimental results, extrapolation to flight	

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

HW/SW capabilities
Availability of aeroacustic wind tunnel and aeroacustics instrumentation

Test article requirements
The wind tunnel models has to be a 1:2 scaled model of the geometries reported in figures 1 and 2 (therefore expected test articles size will be about 3.32 m X 1.27 m for the MLG and about .5 m X 1.5 m for the NLG). The actual landing gear geometry will be provided before activities start and will be slightly different from the one reported in figure 1.

The MLG model should include also wheel and the landing gear bay and doors, but upper fuselage will not be tested. The tset article has to be modular so that different configurations van be tested. The applicant has to present in the proposal solution for a realistic representation of the landing gear including the bay and doors. (Simulation of part of the belly fairing and of both left and right landing gear leg is the preferred solution)

The NLG model should include also wheel and the landing gear bay and door, but fuselage will not be tested. The nose landing gear model has to be modular so that both the complete configuration (wheel, strut, bay and door) and a simplified configuration (only wheel and strut) can be tested. The model has to be provided to GRA members for additional tests in a different wind tunnel if required.

The proposer has also to declare the level of detail he intend to simulate in the test article (cables, screws, …)

Wind tunnel requirements
The wind tunnel test section must have a size sufficient to avoid blockage and wall interference effect and must be properly equipped to reduce background noised and wall noise interferences.

Tests have to be performed at 40 and 60 m/s
Expected background noise should be lower than 80 dB(A) at 40 m/s
The wind tunnel has to be equipped with two microphone array to apply beam forming techniques and must be able to identify the location of different noise source and their intensity
The wind tunnel instrumentation must be able to evaluate the noise reduction obtained by using the different Low-Noise reduction concept

Generic capabilities required vs expected results
The applcant has to demonstrate aeroacustic skill and previous expertise on landing gear noise assesment

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.1	Identification of Low Noise solution	Report describing LN NLG solutions	April 2012
D1.2	Specific design of NLG solutions	Report and CAD files describing NLG LN solution design	
D1.3	Preliminary evaluation of selected solution	Quantitative evaluation of expected noise improvements of each LN solution and selection of solutions to be tested in wind tunnel	
D1.4	CFD/CAA analysis of baseline and some selected low-noise concepts	CFD/CAA analysis of baseline and some selected Low-noise device to evaluate noise improvement, perform comparisons with wind tunnel test and evaluate noise improvement at actual flight conditions	
D1.5	WTT requirements	Test matrix, WTT set-up, instrumentation.	
D1.6	WT model requirements	Report with test article requirements	
D1.7	WT model design	Report with wind tunnel test mechanical design	
D1.8	WT model provision	Test article provision	
D1.9	Test report	Test report including:	June 2013

		EPNDB measurement results …	
D1.10	Final report	Project summary, numerical/experimental results, extrapolation to flight	June 2013
D2.1	Identification of Low Noise solution	Report describing LN MLG solutions	April 2012
D2.2	Specific design of NLG solutions	Report and CAD files describing MLG LN solution design	
D2.3	Preliminary evaluation of selected solution	Quantitative evaluation of expected noise improvements of each LN solution and selection of solutions to be tested in wind tunnel	
D2.4	CFD/CAA analysis of baseline and some selected low-noise concepts	CFD/CAA analysis of baseline and some selected Low-noise device to evaluate noise improvement, perform comparisons with wind tunnel test and evaluate noise improvement at actual flight conditions	
D2.5	WTT requirements	Test matrix, WTT set-up, instrumentation.	
D2.6	WT model requirements	Report with test article requirements	
D2.7	WT model design	Report with wind tunnel test mechanical design	
D2.8	WT model provision	Test article provision	
D2.9	Test report	Test report including: EPNDB measurement results …	June 2013
D2.10	Final report	Project summary, numerical/experimental results, extrapolation to flight	June 2013

4. Topic value (€)

The total value of the proposed package, is

2.000.000,00€
[two millions Euro]

NOTE: The funding to be from 50 to 75% of this maximum budget value. The total value of the activity is composed of manpower, equipment and all expenses associated with the task.

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 the proposal must :

- indicate the tasks to be subcontracted ;
- indicate the sub-contracting partners with skill and expertise description ;
- duly justify the recourse to each subcontract ;
- provide an estimation of the costs for each subcontract.

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

- The expected length of the technical proposal is expected to be between 20 and 60 pages.

Topic description

CfP topic number	Title		
JTI-CS-2011-3-GRA-02-018	**Low Noise Devices aero-acoustics numerical Simulation**	**End date**	1/6/2013
		Start date	1/1/2012

1. Topic Description

Introduction

Within GTI-GRA Low Noise domain several concepts for noise reduction have been proposed and evaluated. For many of such concepts, numerical CFD simulations have been performed. Within the present CfP the applicant will have to carry out aeroacoustic numerical simulations starting from the CFD data provided by the CfP proposers.

Several concepts will be addressed, a wing section including the flap side-edge with and without a side-edge fence, a landing gear geometry with and without low noise treatments.

Technical Information

The technical activity is distributed among two work-packages described here below.

WP1: Flap Side-Edge aeroacoustic analysis

Steady RANS solutions of a wing segment about the side-edge will be provided to the applicant. Then the applicant will employ a stochastic noise generation method to compute the broadband noise generated by the turbulent flow close to the flap side-edge. Three configurations will be considered:

1) a baseline configuration (three-component wing) without acoustic treatments;

2-3) low-noise configurations obtained by adding two different fences to the side-edge of the baseline configuration.

WP2: Landing gear aeroacoustic analysis

Steady RANS solutions of a landing-gear will be provided to the applicant. Then the applicant will employ a stochastic noise generation method to compute the broadband noise generated by the turbulent flow about the landing gear. Three configurations will be considered:

1) a baseline configuration without acoustic treatments;

2) a low-noise configuration obtained by adding an acoustic liner to the walls of the bay

3) a low noise configuration by adding low noise devices

Required HW/SW description

In the proposal the applicant has to provide relevant information on methodology and software that will be used for the analyses, including validation tests performed in previous projects and current hardware capabilities. In particular, the applicant has to demonstrate his capability to compute:

1) the noise propagation taking into account the presence of an acoustic liner and using a physically correct boundary condition;

2) the broadband noise generation from a turbulent flow past a body starting from a steady RANS solution..

Reporting

In addition to the major deliverable reports a bi-monthly progress report has to be prepared by the applicants in correspondence of each planned progress meeting.

Schedule: Meeting and review milestones

Time schedule has to be provided by the applicants in the proposal, but the following key dates have to be respected:

M6: Flap side-edge CAA analyses

M12: Landing gear CAA analyses

M18: Landing gear CAA additional analyses

For each activity the applicant has to provide a final report describing the procedure used for the calculation, the CAA numerical solutions and the corresponding aeroacoustic grids in agreed ASCII file format.

<u>WP1: Flap Side-Edge aeroacoustic analysis</u>

Work description

In this WP the proposers will provide CFD steady RANS solution in an agreed format (FLUENT solution) for two different geometries. The geometries will consist of a part span wing section including the flap-side edge with and without a flap side-edge fence for noise reduction. A total of three different geometries will be provided (baseline, fence-1 and fence-2). The configuration fence-2 will be provided at two different scale and Reynolds number (wind tunnel and flight Reynolds number and corresponding scales). Therefore a total of 4 (four) CAA analyses have to be performed by the applicant.

The applicant will have to evaluate the noise sources by using a stochastic approach and the noise propagation up to an agreed distance from the source. Possibly, wind-tunnel conditions have to be reproduced (model in a wind-tunnel section with rigid walls). Results will be provided in terms of third-octave band SPL noise spectra and power spectral densities at agreed locations.

For the baseline configuration, solution obtained through an unsteady CFD solution and an acoustic analogy integral method will be provided to the applicant for an assessment of the stochastic approach.

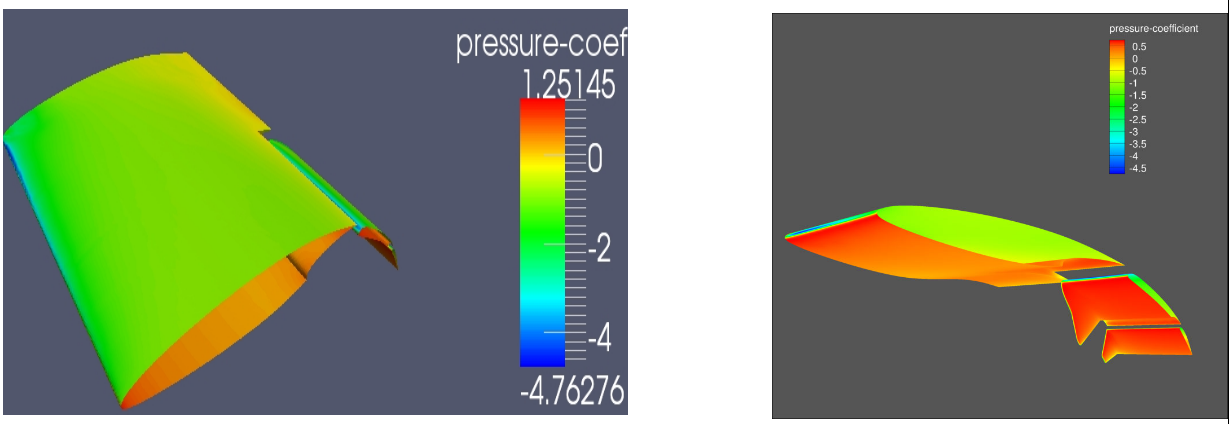


Fig 1: Example of CFD results without (left) and with (right) side edge fence. As is possible to see from the figure the calculation domain consist of a wing part-span

Inputs:

1) Clean geometries (CAD files)

2) Numerical CFD steady RANS solutions in agreed unstructured format

3) Free-stream conditions

4) Microphone locations

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D1	CAA flap side-edge analyses	Report describing the methodologies and the solutions + CAA grids and solution files.	M6

WP2: Landing gear noise

Work description

In this WP the proposers will provide CFD steady RANS solutions obtained by using an immersed boundary approach in an agreed format for two geometries, a baseline and an additional geometry (main landing-gear + bay + doors). The configurations will be analysed at two Reynolds numbers (full size and wind-tunnel model size). Then, for the baseline, the proposer will provide the applicant with a number (to be agreed) of wall impedance distributions that reproduce the effect of liner packs distributed on the walls if the bay. For each impedance distribution, the applicant will evaluate the landing-gear noise and compare the results to the baseline results.

The additional geometry will consist of the baseline with added some passive low noise devices selected by the CfP proposers and agreed with the applicant.

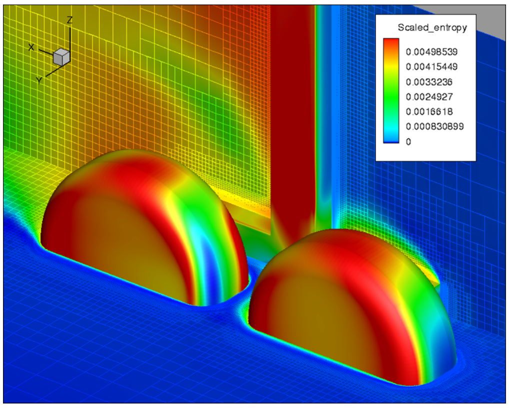


Fig 1: Example of detail of immersed boundary landing gear CFD analysis

The applicant will have to evaluate the noise levels at prescribed microphones in the aircraft reference frame and provide the results in third-octave band SPL noise spectra and power spectral densities.

Inputs:

1) Clean geometries (CAD files)
2) Numerical CFD steady RANS solutions in agreed unstructured format
3) Free-stream conditions
4) Microphone locations

Deliverables:

Deliverable	Title	Description (if applicable)	Due date
D2	CAA baseline geometry landing-gear analyses	Report describing the methodologies and the solutions + CAA grids and solution files.	M12
D3	CAA additional landing-gear analyses	Report describing the methodologies and the solutions + CAA grids and solution files.	M18

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

HW/SW capabilities

Due to the technical complexity of the call and to the short duration of the activities, a proved experience of the applicant in the fields of computational fluid dynamics and aeroacoustics will be a key element of the selection. The applicant is expected to have access to HPC facilities with the necessary computational power.

Generic capabilities required vs expected results

The applcant has to demonstrate aeroacustic skill and previous expertise on numerical noise assesment. In particular, the applicant has to demonstrate the capability to compute noise from a steady RANS solution by using a stochastic approach, and to account for the presence of a liner in the propagation by means of a physically correct boundary condition.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	CAA flap side-edge analyses	Report describing the methodologies and the solutions + CAA grids and solution files.	M6
D2	CAA baseline geometry landing-gear analyses	Report describing the methodologies and the solutions + CAA grids and solution files.	M12
D3	CAA additional landing-gear analyses	Report describing the methodologies and the solutions + CAA grids and solution files.	M18

4. Topic value (€)

The total value of the proposed package, is

150.000,00€

[one hundred fifty thousand Euro]

NOTE: The funding to be from 50 to 75% of this maximum budget value. The total value of the activity is composed of manpower, equipment and all expenses associated with the task.

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 the proposal must :

- indicate the tasks to be subcontracted ;
- indicate the sub-contracting partners with skill and expertise description ;
- duly justify the recourse to each subcontract ;
- provide an estimation of the costs for each subcontract.

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

The expected length of the technical proposal is expected to be between 20 and 60 pages.

The applicant is required to verify the state of art with respect to on-going or past projects on similar subjects, like the FP7-2008 Valiant.

Topic description

CfP topic number	Title		
JTI-CS-2011-3-GRA-03-006	**Development and manufacturing of Programmable Electrical Loads and advanced PSM for Electrical Energy Management testing in Flight Demo**	**End date**	*T0 + 16 Months*
		Start date	*T0*

1. Topic Description

CFP SHORT DESCRIPTION

The objectives of this CfP are:

- the design, developing, manufacturing, testing and delivery of *Programmable Resistive Elelctrical Load;*

- the design, developing, manufacturing, testing and delivery of an *Advanced Power Supply Module* featuring capability to properly modulate input voltage to the above equipment.

The equipment will be used for the scope of the in-flight demo activities of the AEA domain of the Clean Sky GRA ITD. Therefore it will be qualified for installation in the passenger cabin of the Demonstrator Aircraft, selected to be an ATR 72-600.

The *Programmable Resistive Electrical Load* and its *Advanced Power Supply Module* [PSM] have a two-fold purpose:

- to provide a dynamic simulation of a 270 HVDC aircraft *resistive loads*;

- to actuate proper modulation of the 270 HVDC voltage applied to *resistive loads* in order to produce a reduction of the power demand according to the control logics adopted for the Electrical Energy Management (E-EM) of the load.

Even if not mandatory, the following desired will constitute a preference in proposal evaluation process:

- providing the equipment a mathematical model for virtual testing;

- supporting directly (eventually on site) the on ground and in-flight test campaigns assuring Equipment maintenance and repair.

INTRODUCTION

Today electrical system equipment are designed on “add-on” philosophy. They are free to draw power from the generators up to saturation without any control on this request. Distribution system is transparent to this behaviour and it is made up of mere hardware devices providing only wire protection to avoid failure escalation in case of wire fault. This concept relies on the capability to overload the generators which are generally capable to provide 150% and 200% of their nominal capacity for 5 minutes and 5 seconds, respectively. To meet these requests they are oversized both from the magnetic and thermal point of view. Besides, should this not be enough to manage a long lasting overload request, some electrical power consuming loads may be totally shed, as they typically are not flight or safe-landing essential loads. This policy is the so called load management.

The trend leading towards all-electric aircraft with the greening constraint calls for a deep change in the way to manage electrical power provision. First, the total power budget increases and generators rated size becomes higher and higher. This implies that no overload capacity can be taken into account in the design, as long as we want to keep weight and volume within acceptable limits for aeronautical applications.

A solution proposed for the Future Green Regional AEA, to face the major step towards a new concept electrical network, is called Electrical Energy Management (E-EM). Its basic principle is to force global electrical power demand to decrease, even during an extra demand condition. The network voltage applied to some selected (non-essential) power consumers is chopped and it results in power modulation. But, unlike load management, the selected consumer, suffering the power decrease, is far from being shed, as the chopping is pushed just to a predefined extent.

In the framework of AEA domain of the GRA ITD, there is the objective to demonstrate in flight the capability to perform E-EM.

DETAILED DESCRIPTION

Demonstration arrangement

The demonstrator aircraft is an ATR 72-600.

The Demonstration will be organized around an *Electrical Power Center* (EPC) (not objective of this CfP) which will distribute the electrical power from a 270 HVDC bus bar to the *Programmable Resistive Electrical Load*, through its dedicated *Power Supply Module*, and to others electrical power consumers.

Loads selection, control and power supplier monitoring will be performed by a proper *Control Console* (not objective of this CfP).

The EPC will also process the *Electrical Energy Management* (E-EM) control logics and provide signal to the Power *Supply Module* to command the voltage modulation to the *Programmable Resistive Elelctrical Loads.*

The *Programmable Resistive Electrical Load* shall constitute a programmable variable load simulating an aircraft purely resistive consumer; connected to the existing A/C 270 VDC bus bar (Demo Electrical Channel).

Main Requirements

Programmable Resistive Electrical Load

Main power supply: 270 HVDC compliant to MIL-STD-704F.

Power available for auxiliary devices (electronic cards, cooling fans, etc.): *28 VDC or 115 VAC "wild frequency".*

Load nominal power: 20 kW.

Power variation range: from zero to full range with minimum resolution of 100 W over the complete range.

The setting for the load resistance shall come from different control sources:

- *on Local Panel*: capability to vary the resistance by means of control located on the equipment front side panel; the resistance shall be linearly proportional to the control from zero to full range;

- *by External Signal*: capability to vary the resistance by an analogical voltage signal input provided from the *Control Console*; the resistance shall be linearly proportional to the analogical voltage from zero to full range;

- *by Portable Computer (or similar):* capability to programme a load profile through data interfaces (RS232 / USB / IEEE488) accessible from front side; proper software tools shall be provided; waveform editor shall allow comfortable generation of load profiles, dynamic load variations with programmable rise and fall times and simulation of exponential inrush currents.

Actual load, voltage, current and power shall be continuously numerically displayed on front side panel.

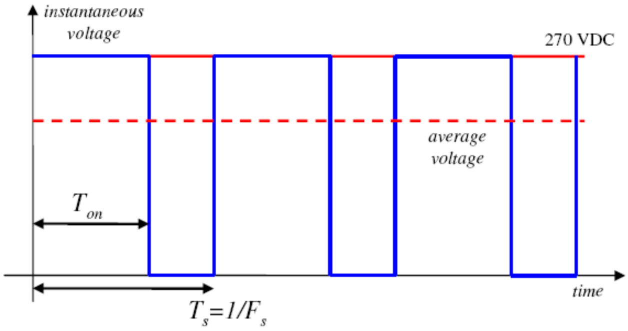
Advanced Power Supply Module

The *Programmable Resistive Electrical Load* shall be connected to the 270 HVDC input through an *Advanced Power Supply Module* integrating *Solid State Power Controller,* which shall perform 270 HVDC high-frequency switching (voltage chopping function), in order to actuate the power modulation on *Programmable Resistive Electrical Load* according to the control logics adopted for the *Electrical Energy Management* (E-EM) of the load.

Voltage chopping switching sequence shall be driven by a signal coming from the EPC.

EPC Command Signal Electrical Characteristics will be specified during early stage of the project.

The voltage modulation applied to the *Programmable Resistive Electrical Load* may be controlled in duty cycle (T_{on} / T_S) as shown in the following figure; switching frequency (F_S) shall be at least 100 Hz. Depending on the above parameters, the resistive loads will sense an average voltage less than the nominal one, thus decreasing the amount of power drawn from the generator.



E-EM voltage chopping

As an objective, it shall be possible to obtain an output average voltage down to 50 % of the nominal 270 VDC voltage.

<u>It is to be intended that the voltage chopping function is not expected to work continuously, but only for short transient periods (about 5 seconds)</u>.

Design Requirements

In general, Civil Certification requirements (CS 25) shall be used as reference when and if applicable.

CfP applicant is requested to put particular attention to equipment weight and volume with respect to the state-of-the-art technology. Therefore any technological improvement aimed to weight and volume saving shall be taken into account.

Interface Requirements

Detailed mechanical installation, electrical and cooling interfaces requirements will be provided as an input in the early stage of the project.

A dedicated procedure and any necessary special tools shall be provided by supplier in order to allow assembly on the aircraft.

Weight

Estimation of the equipment weight raw figures shall be provided by the CfP applicant at the proposal stage at the early stage of the project.

Maintenance and Repair

Because testing at system level on GRA flight test involves a large number of components and suppliers, the applicant will be required to agree to provide level 2 maintenance and to technically support its own equipment for the duration of the tests (which are scheduled until the end of 2015, but may slip slightly) and repair it with diligence in case of failure at no additional cost. The equipment of the applicant will only be handled by qualified professionnals of the GRA consortia. Daily maintenance (normal care which would be performed by the crew or the lineman on an aircraft, and would not require an aircraft mechanic certificate) will normally by performed by GRA flight test operator. The expected number of hours of operation should not require further normal maintenance.

Model for Simulation Activities

The equipment model shall be provided for simulation activities. It shall reflect the actual equipment behaviour in term of static and dynamic main features in order to perform both steady state and transient time domain analysis. The model shall be released in SABER simulation code.

Qualification Tests

The following qualification test activity shall be conducted, as minimum, in order to demostrate compliance with system performance and functionality and assure a sufficient safety of flight level, necessary to allow in-flight test demo application.

Perfomance

1. Functional test

Qualification

1. Temperature
2. Altitude / Pressure
3. Vibration
4. Power Input
6. Voltage Spike
7. Acceptance Test

Safety of flight for in-flight test demo

1. Shock (crash safety test)
2. Constant Acceleration
3. Magnetic effect
5. Electrostatic discharge
6. Emission of Radio frequency energy
7. Insulation resistance
8. Dielectric strenght
9. Bonding /earthing
10. Fire

Standards that will be used as main reference for these tests are:

DO-160F, ISO 2678, MIL-STD-704F, MIL-STD-464A;

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

The Candidate organization shall have:

a. expertise in electrical system design (power generation, power conversion, power network, power consumer),

b. knowledge of Industrial/Aeronautical field constraints and procedures,

c. experience in system simulation methods and modeling,

d. good practice in English language.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
I1	Design Requirements and Data	Input document from CfP manager containing detailed requirements and data necessary for CfP activities starting	T0 + 1 month
D1	Equipment Outline Drawings	Technical document containing overall equipment (Programmable Load + Power Supply Module) dimension drawings and rough weight estimation	T0 + 3 months
D2	Equipment Technical Description	Technical document including detailed equipment (Programmable Load + Power Supply Module) description and performance evaluation	T0 + 5 months
M1	PDR	Preliminary Design Review meeting and associated supporting documentation	T0 + 6 months
D3	Equipment Interface Control Document	Technical document including mechanical, electrical and cooling interfaces	T0 + 8 months
D4	Qualification Test Plan	Test Plan document including as a minimum the following information: • list and description of test facilities, • test equipment list, • specific environmental conditions, • tests description.	T0 + 10 months
D5	Qualification Test Procedure	Technical document including detailed procedures for qualification tests.	T0 + 11 months
M2	CDR	Critical Design Review meeting and associated supporting documentation.	T0 + 12 months
D6	Delivery and installation	Delivery of the complete equipment (Programmable Load + Power Supply Module) with associated documentation (assembly, disassembly, maintenance and functional components manual), and installation on site.	T0 + 16 months
D7	Qualification Test Report	Technical document including also Acceptance Test Report	T0 + 17 months
D8	Declaration of Design and Performance		T0 + 18 months
M3	Support	Support during assembly and test activities (whenever required) until completion of testing activities.	T0 + 48 months

4. Topic value (€)

The total value of this work package shall not exceed:

€ 100.000

[one hundred thousand euro]

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

5. Remarks

The applicant is required to verify the state of art also with respect to on-going or past projects on similar subjects.

Topic description

CfP topic number	Title		
JTI-CS-2011-3-GRA-03-007	**Improvement of numerical models for JTI/GRA Shared Simulation Environment**	**Start date**	T0
		End date	T0+10(Months)

6. Topic Description

Short Description:

This CfP requires the design and the implementation of an object oriented simulation platform for the improvement of a simulation code called SSE (Shared Simulation Environment) developed by the proponent.

The SSE is devoted to the analysis of the electrical loads during typical missions of the all-electric regional aircraft and it integrates the simulation models of the static and dynamic performances of on-board electrical systems. Such models are developed by the proponent using different languages, such as Modelica, AmeSim, Simulink, Saber.

The requested improvement shall cover all software quality aspects (user interface, software stability, software documentation, computational time), being the final scope of the CfP the development of an high-quality simulation environment having the features of an industrial software, to be applied for the design, the testing and the validation of the energy management logics used for the optimal sharing of the total on-board electrical power.

1.1 Introduction

1.1.1 Background

This CfP is part of the WP 3.2 "Technology for Systems" of the All Electrical Domain (AEA) for Green Regional Aircrafts (GRA3). Main objective of the AEA is to find cleaner solutions tested on full scale demonstrators, thus contributing significantly to reduce the environmental footprint of aviation. Today, the widespread means to drive the main aircraft onboard systems is to take the power source from the propulsion system; in the all-electrical domain all on-board systems will be electrically powered. This solution is cause of power absorption issues for electrical generators that can be overcome only with the development of appropriate logics for the energy management.

The WP 3.2 aims at the selection and adaptation of tools and methods suitable for the analysis of electrical loads during typical missions of the all-electric regional aircraft. In this context, a Shared Simulation Environment (SSE), able to simulate the static and dynamic performances of on-board systems, will be developed, with particular focus on electrical power absorption. The final scope of the SSE is to permit the testing and the validation of the logics used by the Energy Management System (EMS) for the sharing of the total on-board electrical power. The thermal energy produced by the systems is also simulated and a Global Thermal A/C Architecture (GTAA) model allows the A/C internal environmental condition to be simulated.

Three levels of increasing complexity for aircraft systems simulation models have been identified:

- <u>Level 1: Architectural level</u>

  Simple and non-dynamic models for the preliminary energy consumption assessment.
- <u>Level 2: Functional level</u>

  Combination of steady–state and simple dynamic models for the preliminary analysis of energy management strategies.
- <u>Level 3: Behavioural level</u>

  Detailed models for the study of the electrical power quality, energy consumption and electrical network stability.

The numerical models for Systems, GTAA, and EMS simulation are being developed at present by the participants to WP 3.2 using different platforms (Dymola/Modelica, AMESim, Saber, etc.) and some of them will be delivered as encrypted software (black boxes). The models will be integrated by the proponent in a preliminary version of the SSE platform, developed using the Matlab/Simulink environment, with the basic objective of verifying model implementations and interfaces. This integration will be performed by the proponent for Level 1 and Level 2 models and, where possible, for Level 3.

All systems models will be available to the winner of this CfP after the supplier selection, together with a description of the preliminary version of the SSE.

1.1.2 SSE Objective

In the next generation all electrical aircrafts the total electrical power shall be shared and allocated in an optimized way among all the onboard systems in order to cope with all the aircraft operational scenarios.

For this reason the EMS has to optimize the use of the electrical power generated onboard by temporary reducing the electrical power provided to some non-critical systems during flights phases and operation scenarios where the total demand of electrical power could supersedes the maximum allowed.

The SSE shall be built around the EMS which will act as a power supplier to the others systems, and around the Global Thermal Aircraft Architecture which will simulate the aircraft internal environment and towards which the aircrafts systems will exchange their produced thermal energy flows in order to adapt the their power consumption in function of the aircraft internal environment.

The EMS, the Global Thermal Aircraft Architecture and the Systems simulation models shall be integrated into the SSE with the objective of:

- Optimize the total electrical power consumption and energy sharing during all flight phases
- Compute each system performances and compare them with the systems requirements.

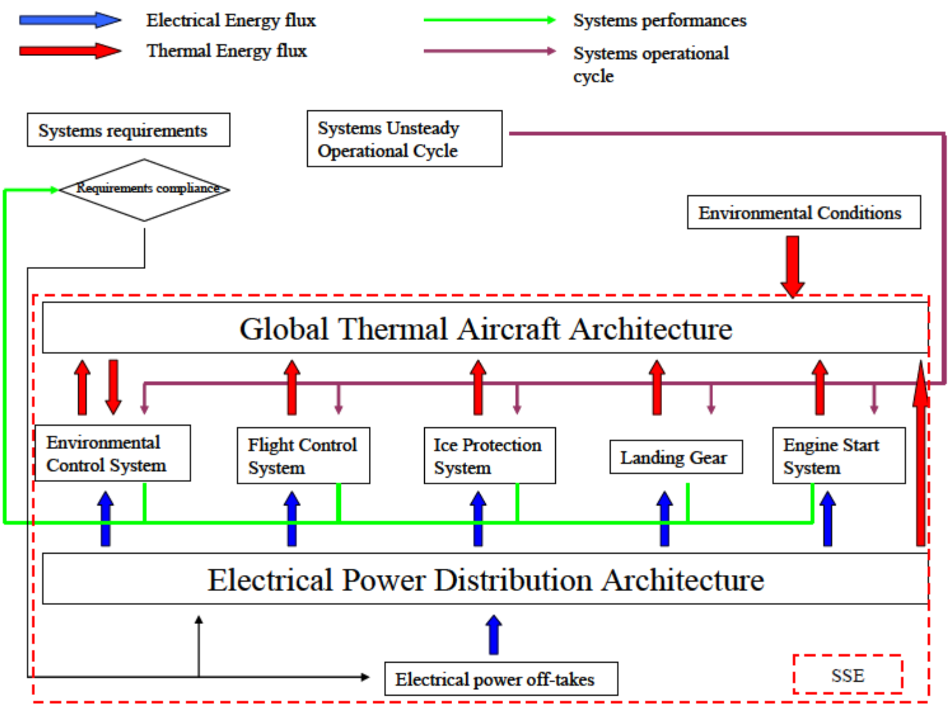


Figure 1 - SSE Systems model integration

1.1.3 Interface to ITD

The selected supplier for this activity will be provided by the CfP proponent after the CfP selection and before the work starting with :

- Definition of the Shared Simulation Enviroment: document defining the requirements and the interfaces of the Shared Simulation Environment software.
- All the Modeling Manuals for the numerical models to be integrated under the SSE, including input/output data for the models provided as "Black Boxes".
- All the Systems numerical models both unencrypted and encrypted (Black Boxes)

The selected supplier shall provide as output:

- The numerical model, to be delivered as a source code.
- The model "Test Vector file" together with a main routine that allows the model to be run and tested
- A Modeling Manual describing the structure and organization of the software.
- A User Manual providing instructions to the user to run the software.
- A Check Manual providing instructions to run the test vector.
- Customer support organization document

1.2 Reference Documents

N/A

1.3 Scope of Work

The selected supplier for this activity shall develop and provide a software for the integration under an object oriented simulation platform of all the embedded aircraft systems numerical models developed by the proponent for the future Green Regional Aircraft (GRA). This shall be an improvement of the SSE platform developed by the proponent in a preliminary form.

The software shall allow all the models to be imported within the new platform or to be run in a dynamic co-simulation, complying with requirements on next §1.5.

Scope of the work is also to provide all the supporting document and Test Vector file as per the previous §1.1.3 as well as providing customer support activity as per §1.6.

The requested improvements of the SSE platform shall be focused on the optimization of the following aspects:

- Integration of the sub-systems numerical models;
- Computational time (in order to allow the simulations of flight missions to be performed in reasonable times);
- User interface (for an easy management of systems parameter and an easy management of the levels of subsystems models);
- post processing features.

1.4 Type of Work

The required type of work for this activity is the development of a numerical code and supporting documents.

1.5 Requirements

A single SSE shall be developed in order to integrate level 2 and level 3 (as defined in §1.1.1) system simulation models as per Table 1. To have a brief overviews of the integration level expected refer to

Figure 1.

It shall be possible for the SSE user to choose the most suitable model's level to be selected for the SSE run.

The software shall be capable of integrating numerical models written in different languages. Tools languages specified in Table 1 are for reference only at this stage, they will be confirmed once the supplier has been selected and before the activity starts.

The supplier is free to choose the most suitable software platform anyway it shall be taken into account that for the CfP proponent the most convenient solution is to use an object-oriented simulation environment.

The numerical model shall be developed in a modular way, so that the CfP proponent can easily modify the subsystems models and the related input parameters accordingly with the GRA project. In addition it shall be possible to modify the model library.

The numerical model shall be developed in order to optimize the Multirate problems that can arise from the integration of different systems simulation models, Runtime problems.

A "single" (unique for all systems) user friendly interface shall be provided for systems input data.

Specific tool for post-processing of simulation data (e.g. time histories of inputs and outputs) shall also be developed and provided.

Models	Level 2 Language	Level 3 Language
FCS	Matlab/Simulink	Modelica
ECS	Matlab/Simulink	Matlab or Simulink
EPGS	Matlab/Simulink	Sypnosis Saber
EDS & EM	Saber or Modelica based tool	Level 3 not necessary
IPS	Modelia	Modelica
LG	Matlab/Simulink	Modelica
Utilities	*TBD*	Level 3 not necessary
Avionics	*TBD*	Level 3 not necessary
FS	*TBD*	Level 3 not necessary
CT	Easy Five – Fortran format Amesim	Easy Five – Fortran format Amesim

Table 1 - All Electrical Systems Levels and Languages

1.6 Customer Support

The selected supplier shall provide customer support activity for a period not less than 12 months starting from the Software final delivery date. The customer support activity to be performed consists of:

- Tool familiarization support
- Resolution of software problems (bugs)
- Minor changes to improve GUI or functionality.

1.7 Schedule, milestones and meetings

A kick-off meeting (KOM), a Preliminary Design Review meeting (PDR), a Critical Design Review meeting (CDR) and a Final Meeting (FM) will be scheduled at the topic manager site. They will coincide with critical milestones (M). The activities will be developed as defined by the following schedule:

Due date	Type of Meeting	Milestone	Description
To	KOM		Requirements review and Planning freezing
To+2	PDR	M1	Code architecture freezing
To+6	CDR	M2	Preliminary Code release
To+10	FM	M3	Final Code release*

Table 2 - Milestones

*At the FM the supplier shall perform a proof simulation of the provided software.

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

The candidate shall have proven experience in dynamic modeling and simulation of aircraft systems. It shall be capable of managing system simulation models provided by third parties and written in different languages thus the candidate shall have the possibility to operate all the platforms described in Table 1.

Answering to this CfP the applicant shall provide the proponent with a resources plan, describing the resources that he intends to use and their curriculum, and with a simulation tools and computational power capability plan describing own proper facilities.

8. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Modeling Manual - draft version	Preliminary modeling document that describes the structure and organization of the software (block diagrams)	To+2
D2	User Manual - draft version	Preliminary user manual document describing user input/output interface; post-processing	To+2
D3	Numerical Model - draft version	Preliminary version of the simulation model	To+6
D4	Customer Support Organization document	Document that describes how the supplier supports the CfP proponent: allocated resources, availability time, type of support etc.	To+6
D5	Modeling Manual - final version	Complete and definitive modeling document that describes the complete model architecture, organization and code	To+10
D6	User Manual - final version	Complete and definitive User Manual document.	To+10
D7	Test Vector File		To+10
D8	Check Manual	Document that describes how to run the test vector	T0+10
D9	Numerical Model - final version	Complete, definitive and tested version of the simulation numerical model.	T0+10

Table 3 - Major Deliverables description and due date

9. Topic value (€)

The total value of this work package shall not exceed:

€ 150.000

[one hundred fifty thousand euro]

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

10. Remarks

(*) The start date (T0) might be adjusted according to the status of the activities of WP 3.2 and/or to the availability of inputs from other WPs.

(**) A reference duration of 10 months is foreseen, nevertheless a modest increase, up to a maximum of 4 weeks, might be negotiable if status of WP 3.2 would permit.

The applicant is required to verify the state of art also with respect to on-going or past projects on similar subjects.

Topic description

CfP topic number	Title		
JTI-CS-2011-3-GRA-03-008	**Control Console and Electrical Power Center for In-Flight Demo**	**End date**	*T0 + 16 Months*
		Start date	*T0*

1. Topic Description

CFP SHORT DESCRIPTION

The aim of this topic is to design, develop, manufacture, test and deliver an Electrical Power Center (EPC) and its dedicated Control Console (CC) for the in-flight demo activities of AEA domain of the Clean Sky GRA ITD. For this purpose, the EPC and the CC will be installed in an ATR-72 (GRA selected flying demonstrator) passengers cabin, being able to interface with the aircraft overall Electrical Power Generation System (EPGS).

The overall equipment (EPC+CC) shall also allow the verification of the innovative Electrical Energy Management (E-EM) concept and control logics. As a matter of fact, due to the ever growing number and power of on-board electromechanical actuators and overall electrical loads, efficacious supervision and management control strategies are necessary in order to reduce the energy consumption so as to optimize the overall weights and volumes of on-board Electric Power Generation and Distribution System (EPGDS).

The E-EM function (operated by the EPC and controlled by the CC) to be tested will consist in applying the control logics to some selected power consumers trying to keep the overall electrical loads within the nominal rate of the generator (40 kVA maximum) dedicated to the demo channel, for each combination of loads in steady or temporary state.

The control logics to be implemented in the EPC (in dedicated electronic boards and/or simulated via software) will be provided by the Topic Manager at the early stage of the Project in the form of logical equations and they will constitute one of the main inputs necessary to start the CfP activities.

Within the above depicted scenario, the CfP main objectives are:

- designing and manufacturing of an Electrical Power Center and its dedicated Control Console for the GRA AEA in-flight testing activities;
- providing outline mechanical drawings and defining electrical interfaces;
- testing the EPC and CC in order to verify main characteristics and performance;
- delivering on site and commissioning of the complete equipment.

The following additional objectives will constitute a preference in the proposal evaluation process:

- providing a software package able to pre-test all the EPC configurations by software before testing in real on the hardware and having the possibility to compare the simulation results and the measurements performed during the real test on hardware. This tool shall also be able to simulate and programme the control logics and Electrical Energy Management algorithms so as to automate the EPC;
- providing a mathematical model (SABER behavioral) of the EPC for virtual testing in an global simulation environment;
- supporting directly (eventually on site) the in-flight test campaign assuring EPC and CC maintenance and eventually repair.

INTRODUCTION

The trend that GRA ITD "All-Electric" Aircraft domain is currently investigating will probably make electrical generators rated size higher and higher. This implies that no overload capacity can be taken into account in the design, as long as weights and volumes are desired to stay within objective figures for aeronautical application. Moreover, most essential loads are changing into electrical power consumers (electrical flight controls, brakes, ice protections, environmental control system, etc.), therefore they can't be easily shed. The way proposed to face these key steps towards a new concept electrical network is an innovative *Electrical Energy Management* (E-EM) distribution policy.

Currently, any abnormal electrical condition (e.g., one generator missed, equipment power-up phase), that results into an extra demand of electrical power, is addressed to the overload capacity of generators. Besides, shouldn't this features be enough to manage the peak power request, several loads may be totally shed as they are not flight or safe-landing essential. This conventional policy is the so called "load management".

By definition, E-EM is an *advanced smart control* of aircraft electrical loads *optimizing weight, volume and consumption*, being able to *"smooth" extra power demands* due to power transients and/or to electrical failures (normally addressed to the generator overload capacity) by compensating them with a proper reduction of the power demand from those loads which are "non critical" for that specific flight phase or operating condition.

It has to be noted that the 40 kVA generator intended to be used on the GRA flying demonstrator is a conventional machine and therefore it does have the capability to be overloaded up to 45 kVA for 5 minutes and 60 kVA for 5 seconds.

The E-EM basic principle is to force global electrical power demand to decrease, even during an extra demand condition. But, unlike the conventional load management, the selected consumer, suffering the power decrease, is far from being shed. However, the shedding of loads (a peculiarity of conventional load management) still continues to be applied, and it may be regarded as a boundary condition of E-EM.

The management of overload capacity is then accomplished *at a distribution level* while the generators are going to be sized for the heaviest power demand which, thanks to the E-EM policy, corresponds to the nominal one.

The EPC controller (implementing the control logics) allocates for the generic load a power request that is function of several parameters, such as:

– Load-peculiar parameters:
  - deterministic and unchangeable (electrical, thermal, ... dynamics);
  - deterministic and function of the specific flight phase or operative mode (priority, critical state);
  - random (load health status, ...).
– Network parameters:
  - contemporaneity and utilization factors;
  - trend towards saturation of generators nominal capacity (di/dt).

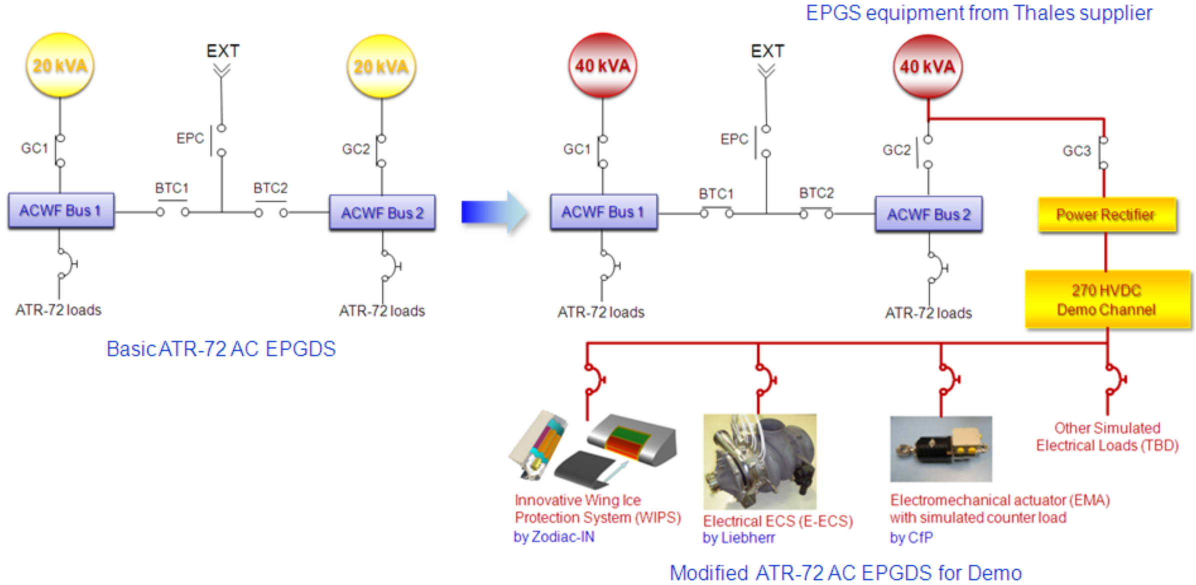
As generators are sized for nominal power only, without any overload capability, *should an extra power demand occur, it will be addressed to a selected "power sink" load*, without any modification to the critical loads power provision (EMAs and hybrid WIPS), but also without impairing the power sink load itself.

The logical function accomplished by the EPC controller can be summarized by the following mathematical relationship:

$$P_i = \mathfrak{F}(par_1, par_2, par_3, \ldots)$$

DETAILED DESCRIPTION

The GRA AEA in-flight demonstration will be organized around the Electrical Power Center with its dedicated Control Console which shall distribute the electrical power from the 270 HVDC dedicated demonstration channel to the demo electrical power consumers (i.e., E-ECS, H-WIPS, EMAs, simulated loads) and it shall also implement and manage the control logics of the innovative Electrical Energy Management concept.



ATR-72 EPGS modification with demo loads for in-flight testing objectives

270 HVDC Demo Channel Network

The increased amount of electrical power demand for the future all-electric regional aircraft would dramatically affect either the size and weight of cables and bundles, or the power losses throughout the network, should the voltage stay at low level. Therefore, the choice of rising the voltage is compulsory to a good design.

In this framework, the selected 270 DC high voltage level is tailor-made on small all-electric a/c needs, being already an aeronautical standard (ref. MIL-STD-704F). As a consequence, all the electrical demo power loads will comply at the input stages with the limits identified in the above standard.

The EPC shall take 270 HVDC power supply from modified aircraft Electrical Power Generation System and it shall distribute the power to the demo actual and simulated load consumers (i.e., E-ECS, H-WIPS, EMAs, simulated loads).

Note: Alternative voltage levels (28 VDC, 115 VAC) will be also available on aircraft for auxiliary power.

Although the limited size of ATR demonstrator Electrical Power Generation System (no more than 40 kVA will be available for demo), the in-flight test activities shall allow the verification of E-EM concept. As a consequence, the in-flight demonstration shall be limited to the following configuration that is compatible with the electrical power available:

– E-ECS (Electrical Environmental Control System): ≤ 35 kW;
– FCS EMA (Flight Control System Electro-Mechanical Actuator): ≤ 3 kW (*);
– MLG EMA (Main Landing Gear Electro-Mechanical Actuator): ≤ 7 kW (*);
– Hybrid WIPS (Wing Ice Protection System): ≤ 3 kW (*);
– Simulated Resistive Loads (non-essential loads): ≤ 20 KW

(* = critical load, power provision non modified by E-EM)

Each demo load can have one or more points of connection to the 270 HVDC bus bar inside the EPC.

Each connection shall be provided through a power switching device (e.g., contactor or relay) driven by the EPC controller and a proper protection device (e.g., circuit breaker), both included into the EPC.

The circuit breakers shall be installed in an operative accessible area of the EPC.

All the necessary technical characteristics of the demo loads (actual and simulated ones) will be provided to the CfP applicant at the early stage of the Project in order to allow a correct interface with the EPC and CC for control issues.

Electrical Energy Management Function

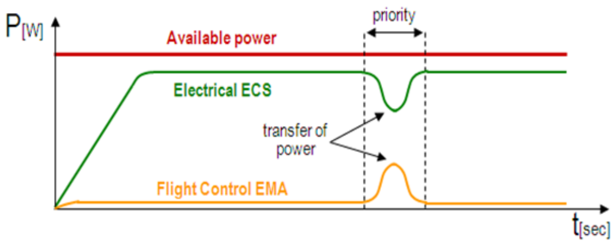
As an objective, the E-EM concept verification tests on the GRA in-flight demo shall consist in applying the E-EM control logics to the demo power consumers trying to keep the overall electrical loads within the nominal rate of the AC generator, for each combination of loads in steady or temporary state. That mainly by:

- enforcement of priorities between power consumers;
- controlled transfer of power without relying on generator overload capability;
- cooperation with network active stabilization function.

The possibility of monitoring the generator total current and its derivative (providing a status on how it is nearing generator capacity saturation) shall give the opportunity to verify the I-LPM concept and control logics.

The EPC shall operate in order to maintain the total demo channel current derivative equal to zero when the current is over a specified threshold near generator saturation; in this case, the EPC shall send logical signals to the E-ECS and to the Simulated Resistive Loads to request the appropriate power degradation.

As part of the Electrical Energy Management experimentation, the E-ECS load will be the “fly-wheel” (i.e., the “power-sink”) from which the necessary power to support the transient electrical conditions shall be taken (without modifying the power provision of critical loads).



E-EM concept

The E-ECS will be the only load suitably selectable as power sink on the GRA in-flight demonstrator (as the power modulation does not affect its well functioning unless its average value overcomes a predefined extent). The E-ECS power modulation shall be completely addressed to the load itself which shall receive from the EPC a command signal only:

$$P_{ECS}^{min} \leq P_{ECS} \leq P_{ECS}^{nom}$$

The delta power P_{ECS}^{nom}-P_{ECS}, that can be tuned on network instantaneous needs, shall stand for the conventional *5 minutes* overload capability of generators, now addressed at distribution level.

The Simulated Resistive Loads power modulation shall be also completely addressed to the load itself which shall receive from the EPC a logical signal. The network voltage applied to the load shall be chopped and it shall result in power modulation. But, unlike conventional load management, this non-essential load, suffering the power decrease, shall be not shed, as the chopping shall be pushed just to a predefined extent. Note that the total shedding shall still continue to be applied and it shall be regarded as a boundary condition of the E-EM.

Modulated power addressed to the *Simulated Resistive Loads*, that shall compensate the short electrical power transients that the inertia of E-ECS motor will be not able to compensate, shall stand for the conventional *5 seconds* overload capability.

The EPC shall continuously monitor the total 270 HVDC current (monitoring shall be done inside the EPC); the total power inceasing derivative shall be compared with the margin from overload threshold; when overload conditions will be foreseen, the following actions shall be performed:

1. EPC shall send an analogical signal to the E-ECS motor driver to request the appropriate power degradation;
2. Power degradation will be performed by E-ECS motor driver until the degradation request is removed;
3. If the overload threshold will be exceeded, a discrete signal shall be sent by the EPC to the Simulated Resistive Loads that will quickly reduce their power absorption until total power is below the threshold.

Control Console

The Control Console shall enable the cabin operator to energize the in-flight demo and to monitor the overall E-EM concept verification.

The CC shall include a panel containing the following control devices:

- Master Switch with power status indication to enable Demonstration Channel energization, interfaced with the aircraft Electrical Power Generation control system;
- External Power Master Switch with power status indication to enable Demonstration Channel energization with ground external power, interfaced with the aircraft Electrical Power Generation control system;
- Manual Switches with power status indication, to control demonstration loads inside the EPC;
- Control keys (i.e. potentiometer) to allow Simulated Resistive Loads setting (from zero to full-range) by an analogical voltage signal.

The CC shall include a display indicating:

- Total EPC input power;
- 270 VDC bus bar voltage;
- Status of the E-EM signals to E-ECS and to Simulated Resistive Loads;
- Specific loads currents.

DESIGN REQUIREMENTS

In general, Civil Certification requirements (CS 25) shall be used as reference when and if applicable.

CfP applicant is requested to put particular attention to EPC weight and volume with respect to the state-of-the-art technology. Therefore, any technological improvement aimed to weight and volume savings shall be taken into account.

The proposal of a Health Monitoring system for failure detection will constitute a preference in the proposal evaluation process.

Interface Requirements

Detailed mechanical installation, electrical and cooling interfaces requirements will be provided as an input in the early stage of the Project.

A dedicated procedure and any necessary special tools shall be provided by CfP applicant in order to allow assembly on the aircraft.

Parameters to monitor

The following parameters shall be monitored as a minimum and made available at the dedicated electrical interface:

- Total EPC input current;
- 270 VDC bus bar voltage;
- Status of the E-EM signals exchanged with E-ECS and Simulated Resistive Loads;
- Specific loads currents.

Weight

Estimation of the EPC and Control Console weight rough figures shall be provided by the CfP applicant at the early stage of the Project.

Support

The applicant shall provide customer support for a period from the date when the equipment (EPC+CC) is delivered in its final form until completion of flight tests (which are scheduled until the end of 2015). Customer support activities shall include user familiarization with the equipment, resolution of possible problems, minor changes to improve functionality. Moreover, the CfP applicant shall guarantee and repair the delivered items in case of defects or damages.

Software for Simulation Activities

The EPC shall be equipped with a software package able to pre-test all the EPC configurations by software before testing in real on the hardware and having the possibility to compare the simulation results and the measurements performed during the real test on hardware. This tool shall also be able to simulate and programme the control logics and Electrical Energy Management algorithms so as to automate the EPC.

The possibility of an automatic or semi-automatic translation of the E-EM strategy from the simulation environment to the electronic boards programming language will be particularly valuable for CfP evaluation.

Model for Simulation Activities

The overall equipment (EPC+CC) model shall be provided for simulation activities in a global simulation environment at behavioral level. It shall reflect the actual equipment behaviour in term of static and dynamic main features in order to perform both steady state and transient time domain analysis. The model shall be released in SABER simulation code.

QUALIFICATION TESTS

The following qualification testing activity shall be conducted, as a minimum, in order to demostrate compliance with equipment performance and functionality and assure a sufficient safety of flight level, necessary to allow in-flight test demo application.

Perfomance

1. Functional test.

Qualification

1. Temperature;
2. Altitude / Pressure;
3. Vibration;
4. Endurance test;
5. Power Input;
6. Voltage Spike;
7. Acceptance Test.

Safety of flight for in-flight test demo

1. Shock (crash safety test);

2. Constant Acceleration; 3. Magnetic effect; 5. Electrostatic discharge; 6. Emission of Radio frequency energy; 7. Insulation resistance; 8. Dielectric strenght; 9. Bonding /earthing; 10. Fire. Standards to be used as main references for these tests are: DO-160F, ISO 2678, MIL-STD-704F, MIL-STD-464.

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

The Candidate organization shall have:	
a.	expertise in electrical system design (power generation, power conversion, power network, power consumer),
b.	knowledge of Industrial/Aeronautical field constraints and procedures,
c.	experience in system simulation methods and modeling,
d.	good practice in English language.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
I1	Design Requirements and Data	Input document from CfP manager containing detailed requirements and data (e.g., control logics in the form of logical equations) necessary for CfP activities starting	T0 + 1 month
D1	Equipment Outline Drawings	Technical document containing overall equipment (EPC+CC) dimension drawings and rough weight estimation	T0 + 3 months
D2	Equipment Technical Description	Technical document including detailed equipment (EPC+CC) description and performance evaluation	T0 + 5 months
M1	PDR	Preliminary Design Review meeting and associated supporting documentation	T0 + 6 months
D3	Equipment Interface Control Document	Technical document including mechanical, electrical and cooling interfaces	T0 + 8 months
D4	Qualification Test Plan	Test Plan document including as a minimum the following information: • list and description of test facilities, • test equipment list, • specific environmental conditions, • tests description.	T0 + 10 months
D5	Qualification Test Procedure	Technical document including detailed procedures for qualification tests.	T0 + 11 months
M2	CDR	Critical Design Review meeting and associated supporting documentation.	T0 + 12 months
D6	Delivery and installation	Delivery of the complete equipment (EPC+CC) with associated documentation (assembly, disassembly, maintenance and functional components manual), and installation on site	T0 + 16 months
D7	Qualification Test Report	Technical document including also Acceptance Test Report	T0 + 17 months
D8	Declaration of Design and Performance		T0 + 18 months
M3	Support	Support during assembly and test activities (whenever required) until completion of testing activities.	T0 + 48 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 Clean Sky program.

5. Remarks

The applicant is required to verify the state of art also with respect to on-going or past projects on similar subjects.

Clean Sky – Green Rotorcraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-GRC	**Clean Sky - Green Rotorcraft**	**3**	**1.322.000**	**991.500**
JTI-CS-GRC-01	*Area-01 - Innovative Rotor Blades*			
JTI-CS-GRC-02	*Area-02 - Reduced Drag of rotorcraft*			
JTI-CS-GRC-03	*Area-03 - Integration of innovative electrical systems*		**1.122.000**	
JTI-CS-2011-3-GRC-03-009	Multi-source regenerative systems power conversion		912.000	
JTI-CS-2011-3-GRC-03-010	Advanced programmable Loads for Electrical Test Bench		210.000	
JTI-CS-GRC-04	*Area-04 - Installation of diesel engines on light helicopters*			
JTI-CS-GRC-05	*Area-05 - Environmentally friendly flight paths*			
JTI-CS-GRC-06	*Area-06 - Eco Design for Rotorcraft*		**200.000**	
JTI-CS-2011-3-GRC-06-004	Dismantling and recycling of ecodesigned helicopter demonstrators		200.000	

Topic Description

CfP topic number	Title		
JTI-CS-2011-03 –GRC-03-010	**Advanced Programmable Loads for Electrical Test Bench**	End Date	December 2015
		Start Date	T0

1. Topic Description

Background:
In the frame of the Eco-Design ITD, verification activities will be performed on an electrical test bench. This Electrical Test Bench (ETB) will support the electrical integration demonstration (generation, distribution, and electrical equipment) and the correlation of numerical models. In order to simulate the most representative electrical network, a various number of equipment (loads) will be developed and tested on this ETB; however, some equipment won't be available and their behaviours from electrical consumption and rejection point of view have to be implemented on the test rig. Such solutions have already been used on previous European research aeronautics' programmes (POA, MOET) with some constraints and limitations that should be avoided for the ETB.

This topic addresses the development of advanced programmable test load banks.

Scope of work:
The subject of this call for proposal addresses different aspects:

- Design
- Manufacturing & integration
- Acceptance on site & commissioning
- Support, maintenance & repairs activities

of a complete programmable load banks system.

The objective is to provide a smart system to simulate the power consumption and power rejection of aircraft's electrical equipment that won't be available on the ETB. The system has to be highly versatile, easy to configure and capable to simulate the power consumption / rejection on different points of the network (possibility to split the system to be physically plugged on different bus bars).

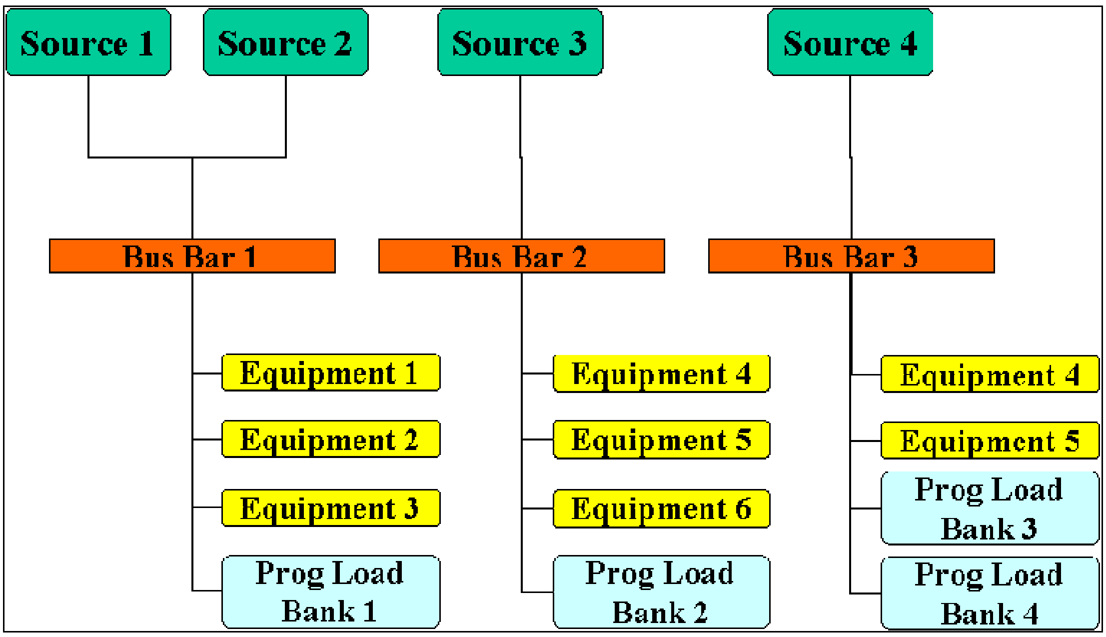


Figure 1 – Electrical Network example

Technical information:

a) Main technical requirements for the programmable loads system:

- Power consumption: between 100 – 150 kW/kVA for the whole system, possibility to split the load banks (preferably physically) in 4 to 6 units of 20-30kW/kVA **mandatory**.
- Power rejection: at least 50kW/kVA for the whole system, possibility to split the system (preferably physically) in 2 to 6 units capable to reject up to 20kW/kVA **mandatory**.
- Load consumption and rejection profiles: highly dynamic loads are expected, switching frequency capability of at least 1kHz mandatory (2,5kHz nice to have).
- Load measurement coded on 12-bits for full load scale (30kW for instance) mandatory.
- Capability to be used on a 270Vdc network and 540Vdc network mandatory. At least 100 kW/kVA can be used on 270Vdc and 50 kW/kVA can be used for 540Vdc network.
- Capability to be used on 3x115Vac and/or 3x230Vac (360Hz to 900Hz) nice to have.
- Load operative mode: constant current, resistance, power adjustable by phase and power factor (cos φ).
- Source operative mode: voltage regulation, power regulation and current regulation onto the aircraft network.
- Pre-programmed models of consumption and rejection onto the aircraft network - based on the supplier information which equipment is replaced by the programmable load bank – can be implemented and operated by the unit itself.
- The unit shall also be operated by an external control system.
- An impedance adaptation depending on the network configuration shall be allowed for each unit of the programmable load bank (considering input filter limitation).
- The whole system (when all the elements of the system grouped together) have to take up in a maximum surface area of 9m² (3mx3m) and no more that 2.5 m high.
- The system must comply with the relevant regulation / standards (electrical safety, EMC, etc.).
- Operating environment: the system will run in a laboratory environment (temperature between 10°C to 40°C).
- The system will have its dedicated local control system (LCS), it will communicate and be synchronized with the General Control System (GCS) of the ETB including safety devices connections.
- 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 system is remotely controlled from the control room and the Human Machine Interface is reported in the control command room.

b) Information regarding the system’s installation on 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.
A working area will be dedicated to the programmable loads system. The interfaces with the ETB are performed through 3 boxes:

- CSI: Control System Interface: allow the information exchange between the local system and the ETB (synchronization between the system and the other equipments on ETB, measurements, curve profiles for consumption / power rejection, etc.).
- AEN: Aircraft Electrical Network: Panel to connect the programmable loads to the electrical network of the simulated aircraft.
- IEP: Industrial Electrical Power: used to get standard electrical power (ancillaries) for computers, etc.

The dedicated area is a 3m x 3m surface. Cold water and pressurized air are available if required.

NB: the different load banks can be plugged on the same AEN box or connected on many AEN.

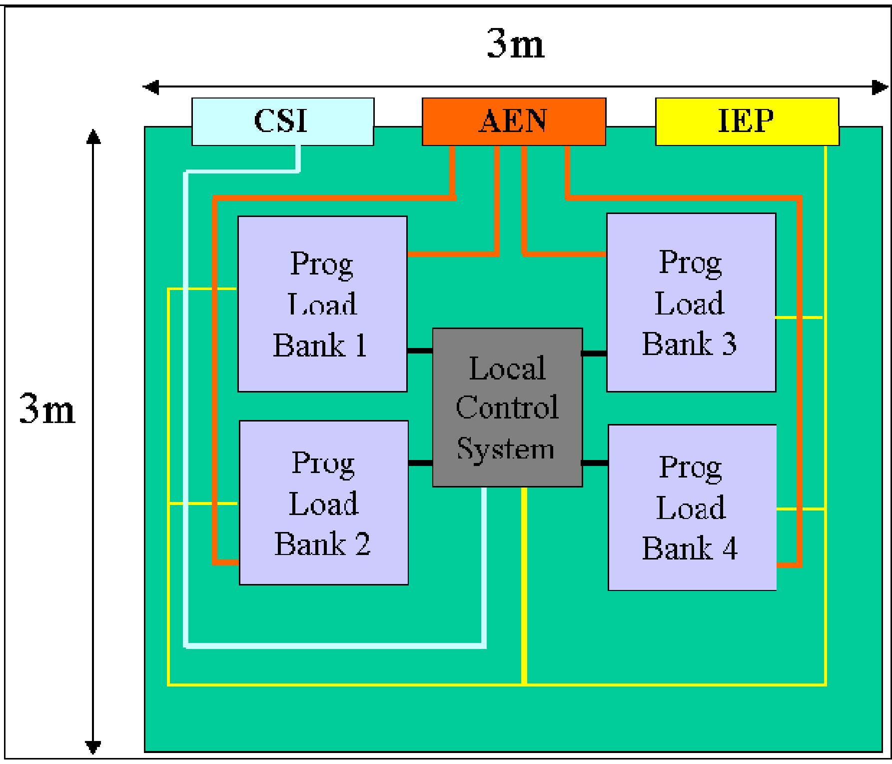


Figure 2 – Installation of the system on ETB (principle)

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 / curves and commands from the overall bench (when in this mode).
Each unit (Prog Load Bank "X") can be controlled in a different source / load mode strategy (described above) at the same time, independently. Limitation may be introduced according to the solution chosen by the partner.
The local system controls current, voltage, resistance, power 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 10kHz) to the overall test bench (current, voltage, resistance, power, etc.)

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.
The local control system as shown below in the figure is in the scope of the CfP partner. The global control system of the ETB is not provided by the CfP partner but interfaces must be considered in order to allow a "distant remote control" mode.

c) The programmable loads system supplied through this CfP will include:
- Load banks with rejection capability, in accordance with the requirements describe above.
- Measurement means: current, voltage, etc.
- Local control system, with functionalities in accordance with the description above.
- System internal cabling and associated protection., including cabling to be connected to the different cabinets (CSI, AEN, IEP) for the whole system.

- Specific ancillaries and Cooling system if needed.
- 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, including spare parts, repairs activities and support.
- Documents:
    - Detailed documentation (detailed description, operations, protocols)
    - Safety analysis
    - Electrical and mechanical interfaces drawings
    - Maintenance procedures

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

The proposal should include:

- Detailed study of the solution.
- Manufacturing / integration of 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.
- Support, maintenance and repairs activities for the project duration.

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:

- Power rejection on aircraft electrical network: if the power consumption can be considered as a standard test mean, the power rejection is a highly valuable capability for a programmable load system. It would allow the study of network quality and stability when loads (like EMA) reject power on the network instead of wasting it by heat.
- Curve profile for load and power rejection strategy.
- Programmable loads with high dynamic and very small step unit.

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 programmable load banks system for the ETB regarding existing test rigs in aerospace industry.

Criteria to meet:

The system will be as compact, robust and optimised as possible: the system (load banks, local control system, instrumentation, cooling 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
- 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 criterion for the CfP.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	PDR	Preliminary Design Review	T0 + 4 month
D2	CDR	Critical Design Review	T0 + 7 month
D3	Manufacturing and delivery	Delivery of the complete systems	T0 + 13 month
D4	Commissioning and acceptance	Acceptance of the complete systems	T0 + 18 month
D5	Support, maintenance & repairs	Further to the commissioning on site, the CfP Supplier shall support the rig operations to correct potential faults during the Clean Sky Program.	December 2015

Detailed list of deliverables and milestones will be defined with the CfP partner in the Description of Work.

4. Topic value (€)

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

€ 210,000

[Two hundred and ten thousand euro]

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

Topic Description

CfP topic number	Title		
JTI-CS-2011-5-GRC-03-011	**Multi-source regenerative systems power conversion**	Start Date	T0
		End Date	T0+ 24

1. Topic Description

Background:

A new concept of electrical power management is under research on Clean Sky's Green Rotor Craft ITD. This study seeks to develop fully regenerative power systems converters and control allowing energy recovery and distribution between multiple source and load devices on a common power system bus.

An integrated approach to a generic **power converter** and associated control system in a system context is required with the capability to manage and integrate bi-directional power flow between devices and buses on a **270V DC power distribution network**. These are to be integratable to form **scalable multiple device and converter** systems

A critical capability of the converter is the support of energy recovery, and storage into **energy storage systems** with the flexibility to exploit the most recent and emergent energy storage technology developments.

Future Rotorcraft will be equipped with more energy efficient electrical devices. Some of these will be able to regenerate energy into the bus.

The converter system will provide the capability to recover and store some of the regenerated energy and later use it during peak power demand periods.

The converter and associated control is therefore to include capability to manage regenerated and stored energy to reduce the overall load demand from engine driven main generators, thus lowering the fuel consumption.

To demonstrate systems capability, reliability and performance, and analyse its response and efficiency a Test Rig shall be developed and built allowing for further evaluation of this as well as future system upgrades.

The converter and control system is to be demonstrated as an integrated power system in conjunction with representative regenerative systems and storage devices. This will include demonstration at the Clean Sky fully integrated power system 'Copper Bird' facility.

Scope of work: The proposal shall support the following work program :

- Preliminary study defining conversion, regeneration, and storage management functions and capability requirements
- Systems power management hardware and software capability requirements study (including algorithms and interfacing to storage devices);
- Preliminary study of the Power Converter design;
- Preliminary study of the system power management and control system design;
- Power Converter and management system failure modes and effects robustness analysis;
- Generic design optimisation including, scalability, mass and cost reduction;
- Capability and performance modelling
- Power Converter system design, development and prototyping;
- Design and integration of the Energy storage technology, and management method;

- Energy storage method prototyping;
- Test rig design, development and prototyping;
- Test rig failure and robustness analysis;
- System Integration;
- Compliance and scenario based functionality and performance testing and demonstration.

The work shall include an **initial study to determine potential design options in conjunction with a European airframe manufacturer** including software purposely designed for the Power converters operation while taking into account **Safety and Certification factors**. Redundancy and failure reconfiguration capability shall be implemented. The Energy storage method and technology shall be included leading to the development of a prototype for integration into the test Rig. The initial study will be reviewed as part of an interactive program with the airframe manufacturer to form the basis for the detail solution specification and design.

Capability and performance shall be used to determine viability and models shall be provided, preferably in an open file exchange enabling independent dynamic model run by the associated airframe manufacturer under Matlab / Simulink.

The Test Rig should be developed to reproduce the Rotorcraft main electrical devices. It shall be capable of simulating different loading, regeneration and storage scenarios. This Test Rig will be used for checking functionality, performance, system/sub-system failures, redundancy and robustness. Additionally it shall be capable of assessing system efficiency, during several scenarios to be defined latter in collaboration with the Topic Manager.

All Test rig devices may be scaled down in terms of nominal power, in order to reduce the project costs, providing however no detriment is caused to the rig performance, capabilities and accuracy. This may be addressed during negotiation phase. Example current technology storage devices must be provided for storage performance, test and demonstration. However these can be low cost or low TRL devices to permit a cost effective program to be achieved.

The preferred solution shall be developed into a technology demonstration architecture design targeted for demonstration at **Technology Readiness level (TRL) 6**. It is recognised that the responder may wish to offer some elements of the system and converters at TRL5 to provide a cost effective program. This is a non-preferred TRL, but may be considered if justified. At least one example converter at TRL6 should be achieved in all proposed cases.

Power Converter

<u>Critical characteristics</u>

The desired Power converter characteristics are shown in **Error! Reference source not found.**. All these characteristics must be taken into account during design and prototype stages.

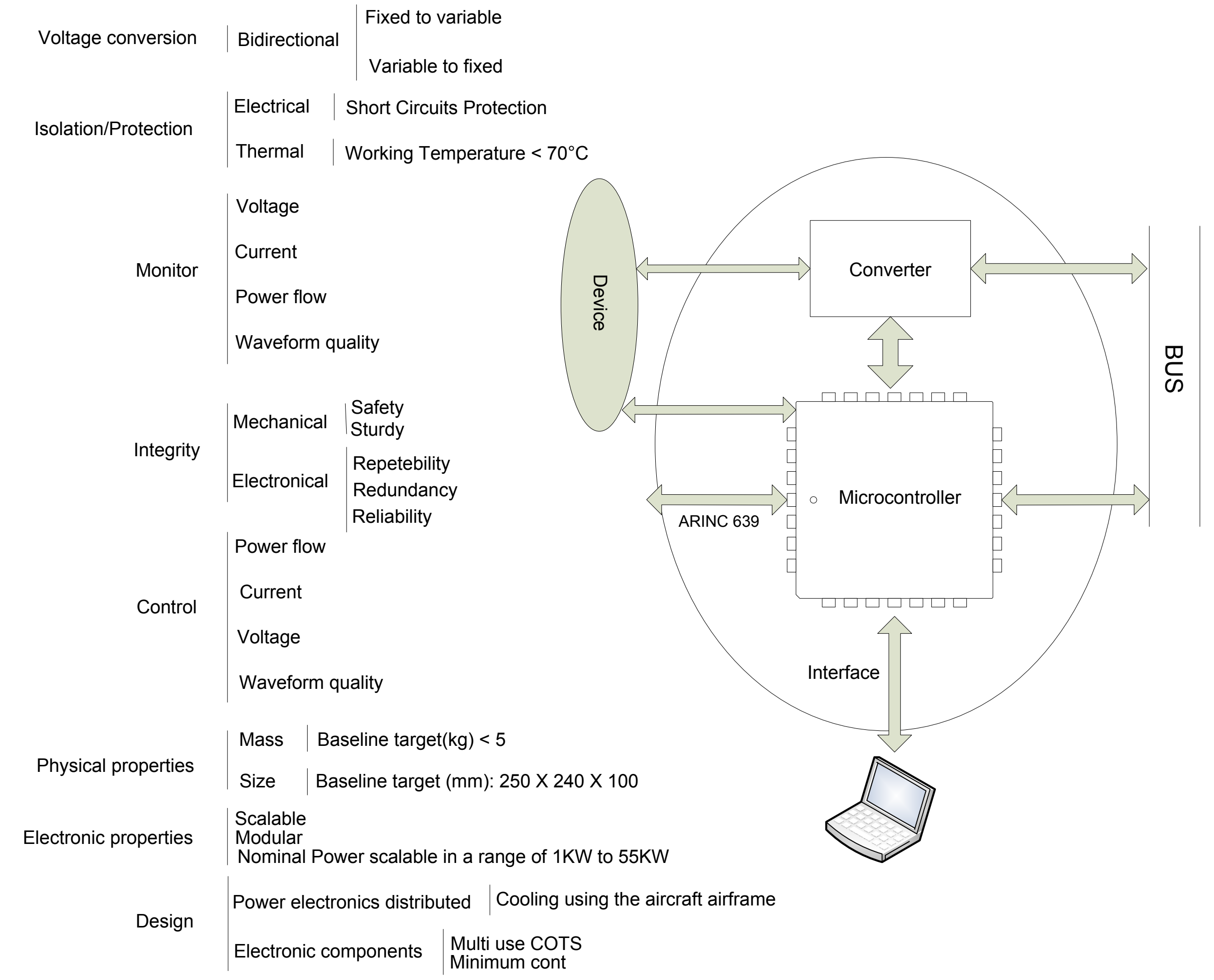


Figure 1-Power Converter overview

<u>Power converter considerations:</u>

An example power converter architecture is provided at figure1 only to illustrate the anticipated components and key factors in achieving capability. It is not intended as a requirement for the converter design

- The Power Converter should be designed support the factors outlined in **Error! Reference source not found.**;
- At device side the system must go from 28V DC comply with MIL-STD 704F standard to 270 VDC, it should however also be reconfigurable to support up to 540V DC network.
- A Microcontroller is responsible for managing and controlling the Power converter; it shall also be able to disconnect the device in case of any faults;
- The Microcontroller should have an ARINC 639 communication reserved to control the device within an integrated control architecture if needed;
- An Interface port will be required to connect the Power Converter to an external device with capability to monitor read and write data, and reprogram the Microcontroller;
- The Power Converter will be linked to the others by a robust bi-directional wire Communication system, (ARINC 639.
- This is intended to provide two advantages. Primarily it allows mass gain on cables, exploiting

the Central Control Unit (CCU) communication with all units using the same BUS.

Secondarily it enables implement algorithms to avoid events such as, voltage peak/sags when one or more devices "simultaneously" starts/stop to source power to the bus. The intent is to keep the BUS voltage stable (MIL-STD 704F - 270V DC) while maintaining the overall system as reliable and safe as possible.

The converter interfaces should be designed so that the interface physical medium may be upgraded in the future (for example to a wide bandwidth fibre optic link);

- Modular design is encouraged to support product development and technology migration flexibility. The Power converter should be divided in two parts, **command (Power electronics) and control (microprocessor)**. The responder must design these two parts as independents in a **modular and upgradable way**. These will keep the system compatible for future lower or higher power devices with slightly different power electronics;
- The Power Converter is to provide the primary interface for non 270V loads and energy recovery/storage devices within an innovative storage system. The responders should therefore make algorithm, control and interface software upgrade provision to permit software configuration to characterise and optimise the charge/discharge/balancing characteristics;

It should be noted that all system development must consider the **prospective aviation certification process** hence, safety requirements must be satisfied by proposed solution according with certification standards.

Energy Storage

Aircraft have a wide range of device load demands and potential regeneration, including sudden high power surge loads and regeneration pulses generating a complex overall load profile. The storage system must provide power quality improvement, smoothing and mitigating the voltage sags and other power disturbances. Power flow between loads, sources and storage devices must be managed to maintain existing standards of constant voltage profile on the aircraft power distribution bus (ses).

An example storage and implied energy profile is given in **Error! Reference source not found.**. The responder should study the best solution to meet the requirements of the **Error! Reference source not found.** and in consideration of Aircraft safety certification standards:

Note: When considering aircraft certification the impact on service reliability and failure modes likely to affect the aircraft operation must be considered when determining component performance rating particularly in preventing catastrophic component failure from uncontrolled power surges

The battery based storage system will have four main functions :

- Engine start capability;

- Emergency power during loss of generator output (including flight control actuators);

- Hold up avionics power during start-up/shut down.

Error! Reference source not found. indicates the critical performance achieved. The energy content should be considered as a target baseline for other rapid storage systems such as capacitors. However converter performance should include the rapid charge (full energy transfer) rate of a capacitor based storage system at the same rate as the burst power (20 seconds).

Battery Nominal Voltage	270V
Battery Capacity	40Ah
Burst Power	60KW (10 seconds)
Working Temperature	Down to -18°C, and ideally -30°C
Fast Charge	
High Discharge Currents	
Small Size	
Safety and sturdy	
Light Mass	
Desired life	5000 engine start cycles and 5 years

Table 4- Storage system characteristics

Test Rig

Error! Reference source not found. shows the outline architecture of the Test and system demonstration Rig.

Each 'D' corresponds to a device that will be connected to the BUS using the Power Converter as an interface. These will include regenerative, variable voltage devices. A separate instance of a converter is shown specifically interfacing to a storage device. This is shown to clarify the specific need for this interface management as a generic capability common to all power converters.

'LOAD n ' represent generic loads and may be always ON, or have an ON/OFF variable state according to a duty-cycle, or have a variable load according usage selections the R/C Illumination, Such loads consist of avionics equipment, hoists, solenoid valves and etcetera.

'Main Generators' represents the helicopter main power supply generation source, powered by the aircraft main lift gas turbines. It should be assumed that there will typically be at least two separate main generator devices rated together to source power to the maximum expected demand of all loads capable of being operated simultaneously working at nominal power.

The responder should assemble five Power converter prototypes for the test rig purpose.

All Power Converters and CCU are to be interconnected using a wire communication (Ring topology). This shall be configured to provide redundancy in both communication and processing.

Monitoring and management of all loads shall by default be coordinated by the CCU to include coordinated management of power flow including; flow to sources and stores, management of excess load demand, cycling non essential loads, failure management etcetera.

The system shall control generator demand and operation by management of regenerated and stored energy on the distribution bus via the CCU. The system shall include the capability to adjust the power output of generator sources in real time including disconnection.

The **CCU software capability** (in real time) should include:

- Turn ON/OFF every device including the Power Converters;
- Manage power feed to the bus from non-generator sources (regeneration / storage) via the converters to balance (i.e. reduce) the Main Generator power demand. ;
- Monitor and regulate the system and individual Load consumptions to apply individual protective demand overload load management via cycled ON/OFF duty-cycle disconnection.
- Automatically adjust the system converters to the specific device D characteristics;
- Continuously sample monitor all system bus and devices voltage, current and power;

- Monitor the Converters health status;
- Monitor the system for abnormal voltage, current and power level waveform conditions;
- Automatically reconfigure, disconnect and apply emergency load disconnects and stored energy usage as necessary to preserve essential services in the event of supply failures
- Monitor the battery charge rate and stored energy level.
- Monitor and manage capacitor based energy storage and usage.

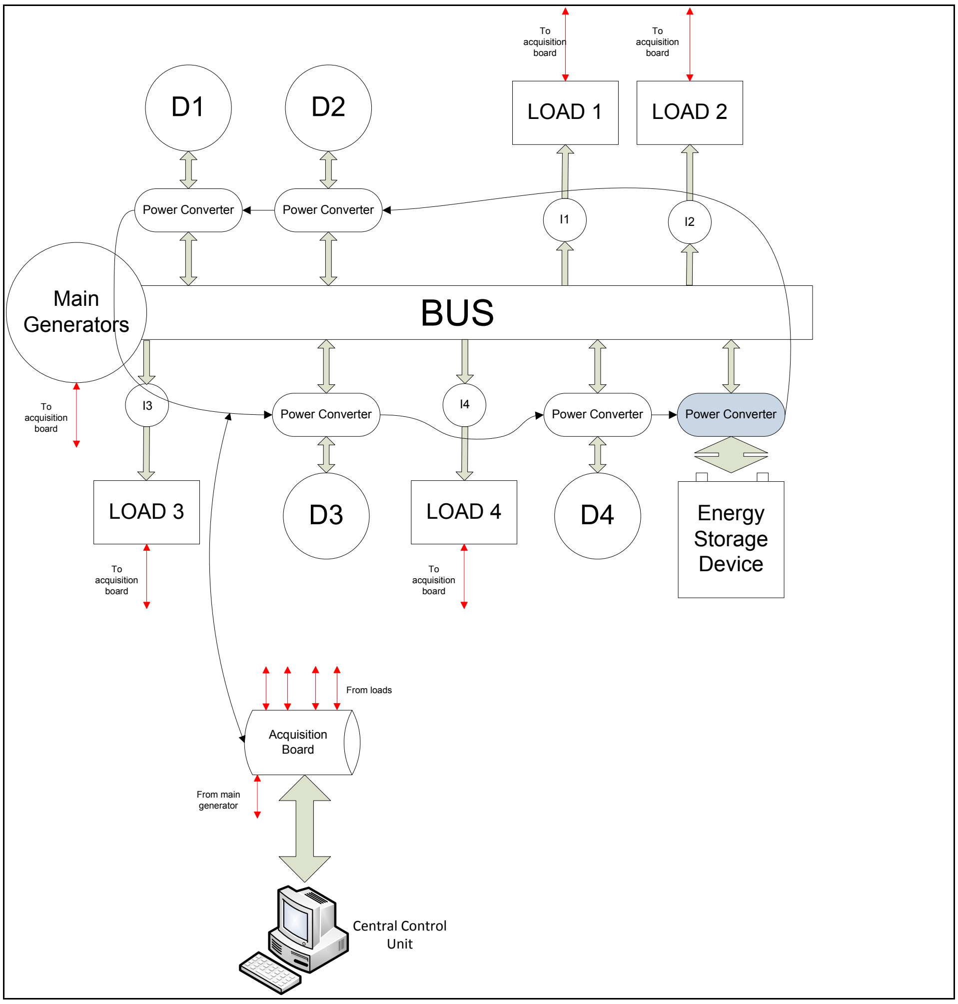


Figure 2-Power management Test Rig

Further Considerations:

- Low mass, small size, high reliability, and system safety are critical factors to be considered in design. The system must add net value to the aircraft in terms of efficient energy management capability and reduction in aircraft fuel use including reduction of direct generated power demand and reduced aircraft mass.

- It Is important to note that the capability is sought for active coordinated management of all energy sources in a coordinated way that has management redundancy. A central common CCU is therefore indentified to be used to achieve this in a range of operational and mission conditions. The system must have a robust and reliable self-failure management and recovery capability. Therefore the Power Converters should be capable of working as standalone units, without any aid from the CCU. The intent is to demonstrate system operation in failure modes (including loss of CCU) on in the test rig.

- Commonality should be exploited to reduce installation, cost and maintenance. The CCU should therefore be used to provide in flight Health and usage monitoring for predictive and diagnostic maintenance and support ground maintenance. An example implementation monitoring, processing and algorithms shall be included to demonstrate the potential capability;

- The Test Rig should be modular in order to maintain the system upgradable for future applications.

The aim of the test rig is to assist development of design, prove the convertor and CCU system capability, and assess and demonstrate the overall power system efficiency against generator power demand. This will be under different scenarios and analysing the system response.

A final report should be prepared showing the system response to devised range of load usage, regeneration and configuration scenarios. **These scenarios will be discussed and defined during the negotiation phase.**

General Requirements:

- The system must protect wires from over current and other faults (early arcing detection or deterioration of cable characteristics increasing susceptibility would be a valuable feature);
- The Power Converter interface plug shall be Ethernet;
- The serial communication protocol between Power converters shall be ARINC 639;
- The equipment shall be able to operate at an ambient temperature of 70 °C without cooling fans;
- The basic reliability requirement is expressed as MTBF (Mean Time between Failures). The MTBF shall not be less than 15000 Flight hours (1 Flight Hour=1.25 Operating hours);
- The Power Converter shall be modular and his replacement on-aircraft shall be made in less than 15 minutes, assumes ready access;
- The MTTR (Mean Time To Repair) off-aircraft shall be less than 0.5 hours the above time includes diagnosis, repair and test;
- Each equipment shall be designed aiming to obtain the lowest weight compatible with the maximum operative life;
- Units should be designed in order to avoid the use of special tools for installation, inspection and testing;
- The use of non approved components shall be avoided. The approved components mean components qualified by the relevant national standards which are in general use in the aerospace industry.

This call seeks to establish a new innovative development in airborne power management. It must therefore be designed to demonstrate 'Ecolonomic' factors including scalability, adaptability and commercial viability to support its future development and adoption.

2. Special skills certification or expected equipment from applicant

Experience should include Power Electronics, Microcontrollers, Communication protocols and High level Software programming (LABVIEW, MATLAB or similar). Capability to design, implement and test all required Hardware.

It Is also necessary to be familiar with Aircraft safety certification standards and analysis such as:

MIL-STD-704F, Aircraft electrical power characteristics ;

MIL-STD-461, Requirements for the control of electromagnetic interference characteristics of subsystems and equipment;

MIL-STD-5088L, Wiring, Aerospace Vehicle;
MIL-STD-202G, Test Method Electronic and Electrical Components;

MIL-HDBK-217F, Reliability prediction for electronic component;

CS-29, Certification specifications for large rotorcraft.

3. Major deliverables and schedule

Deliverable	Title	Short Description	Due Date
D1	Cardinal Point Specification	Finalized Statement of Work. Preliminary design proposal including trade-off studies programme. System design, capability and performance objectives.	T0+2
D2	Trade-offs Final Version	Trade-off Studies final document issue. Including final design intent and system/sub-systems architectures.	T0+6
D3	Preliminary Design Review	Preliminary design review and supporting documents. Technical documents including Safety assessment documentation package.	T0+10
D4	System Design Progress Report	Comprehensive review of all topics as outlined in above CfP. Technical Design, Development/Procurement documentation.	T0+12
D5	Critical Design review	Critical Design Review and complete system design, models, analysis, and test documentation suite.	T0+18
D6	Prototype Presentation	Functional Prototypes "delivery" including test rigs and spare components.	T0+22
D4	Final Demonstration	Complete system functional demonstration, final reports, technical documentation package and scenario testing evaluation.	T0+24

4. Topic Value

The total value of this work package shall not exceed:

912.000 €
(Nine hundred and twelve thousand Euros)

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

5. Remarks

This CfP one of a co-ordinated series of technology developments under the Clean Sky Rotorcraft ITD supporting energy reducing electrical power systems and it is intended that where practical common compatible approaches will be developed. In addition the demonstration implementation should allow its inclusion in a common systems rig environment.

The responder is therefore asked to include provision in the program for the interactive development of the design, and the test program as co-ordinated by the Topic Manager.

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-GRC-06-004	**Dismantling and recycling of ecodesigned helicopter demonstrators**	**End date**	T0 + 18 months
		Start date	T0 = April 2012

1. Topic Description

Background:

The objective of CleanSky Green RotorCraft 6 is to design and manufacture rotorcraft demonstrators, such as airframe and transmission parts, by using ecoefficient materials and processes.

The goal is to achieve a cost and weight saving compared to today's solutions by integrated design and reduced number of manufacturing steps (including assembly, surface finishing, reduced re-work, recyclable products) and by being easy to dismantle for recycling.

The demonstrator is based on airframe structures out of thermoplastic composites with novel (read: more environmentally friendly) surface treatments.

Examples for thermoplastic composites are helicopter doors, skins, stringers, shafts and fittings. The thermoplastic composites are based on stiffened skin structures likely made of carbon fibre reinforced PEI, PPS, PEEK or PEKK and combinations with other materials, e.g. metal attachment parts, polymer windows, sandwich cores, thermoset repair patches, etc. are possible.

The main goal is to make a qualitative analysis considering dismantling and recyclability of such helicopter elements based on thermoplastic composites, including assessment of the possibilities for recycling, verifying environmental aspects, demonstrating at least one end-of-life solution on an available demonstrator part, cost analysis of the end-of-life steps and supplying of quantitative input for the life cycle assessment tool.

In other words, an assessment shall be made of the possible end-of-life scenarios and impact on the total demonstrator life cycle, with the aim to propose an end-of-life scenario, that provides the most favourable ecoefficient impact. Inputs should be provided to the design stage where possible.

Scope of work:

The applicant is responsible for the following tasks:

- Collect and assess possible end-of-life scenarios, such as dismantling and recycling, for particular helicopter structures based on composite materials and technologies, leading to preferred scenarios. This task has to be carried out by considering that there are two demonstrator activities in parallel (two based on thermoplastic technologies), which are independently developed by two company groups.
- Investigate dismantling, the reformability and remanufacturing, and possibilities of reuse of the dismantled and remaining structures, including part replacement.
- Investigate the design influence on the end-of-life possibilities, and provide design recommendations
- Demonstrate the preferred scenarios (the best possible solutions based on today's or near-future technologies for dismantle and disassembly, possible reuse, and materials recycling) for the two selected demonstrators (see below). This means to define with the cooperating companies a dismantling plan and carry out demonstration activities for meaningful dismantling processes.
- Collect and provide input for the Life Cycle Assessment tool

Below, an overview is given on the selected demonstrators to define the work volume and help the applicants to answer to the call for proposal. Two demonstrators based on one technology field can be identified: thermoplastic composites (WP 6.1.5 and WP 6.2.5).

Note: The demonstrator will be manufactured and provided by the industry partner.

GRC6.1.5: Thermoplastic composite pilot door structure

The door demonstrator will be based on structural thermoplastic composites with either PPS (polyphenylene sulphide), PEI (Polyether Imide), or PEKK (Polyether ketone ketone) matrix and continuous carbon firbes. These materials have the promise of easy dismantling and recycling and possibly reforming. The aim of this WP is, therefore, to investigate the possibilities to fulfil this promise to improve the life cycle carbon footprint.

GRC6.2.5: Demonstrators for Thermoplastic Structural Parts

Thermoplastic reinforced with carbon fibres can be used in primary structures. The main advantage shall be evaluated from the reduced number of manufacturing operations and the weight reduction as well as the saving due to simpler material handling and storage operations.

The reference part is the same structure made with CFRP thermosets, such as a rear upper panel, fuselage sponson fairing and radome.

GRC6.4.5 Thermoplastic Composite Shaft for transmission parts

A thermoplastic Composite shaft is foreseen that will be bonded to the metallic

Work package	Part	Weight (g)	Materials/ technology
WP6.1.5	Door frame	~3000	Continuous carbon fibre reinforced thermoplastics (CFRP)
	Window	~500	Thermoplastic
	Attachment parts		Metal, … (optional)
WP6.2.5	Skins		CFRP Thermoplastic laminates
	Stringers/Longerons		CFRP Thermoplastic laminates
	Attachment parts		Metal, … (optional)
WP6.4.5	Shaft	20000	CFRP Thermoplastic laminates

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

The applicant (single organisation or a consortium) should include research laboratories, institutes and/ or companies having the following facilities and knowledges:

- Strong knowledge on aerospace materials (CFRP with thermoplastic as well as thermoset matrices)
- Extensive experience and capabilities for disassembly, dismantling and recycling of composite materials
- Extensive experience and capabilities for collecting data that serve as input for a life cycle assessment tool.

3. Major deliverables and schedule

Deliverable	Title	Short Description (if applicable)	Due date (month)
D1	Concerted plan for dismantling demonstration activity	Report with accurate definition on the dismantling activity based on consultation of the different actors	T0 + 2 (months)
D2	End-of-life technologies report	Report with assessment and recommendation of suitable end-of-life technologies for GRC6 demonstrators	T0 + 6 (months)
D3	Feasibility demonstration for composite structures	Experimental proof of ecolonomical feasibility of selected End-of-life scenario	T0 + 12
D4	End-of-life technology demonstration report on TPC demonstrators	Report with results of demonstration of End-of-life technologies on TPC composite demonstrators	T0 + 18
D5	Software file with input for life-cycle-assessment tool		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 (VAT not applicable)** **[two-hundred-thousand euros]**

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 candidates should know that, in case that they are successful, they would have to sign an implementation agreement with several industrial companies with a binding commitment to protect confidentiality of their own proprietary data.
- The expected length of the technical proposal is 20 pages.

Clean Sky – Sustainable and Green Engines

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	**4**	**7.400.000**	**5.550.000**
JTI-CS-SAGE-01	*Area-01 - Geared Open Rotor*			
JTI-CS-SAGE-02	*Area-02 - Direct Drive Open Rotor*		**6.200.000**	
JTI-CS-2011-3-SAGE-02-009	CROR Propeller blades		4.000.000	
JTI-CS-2011-3-SAGE-02-010	Contra-Rotating Open Rotor (CROR) Propeller barrels		2.200.000	
JTI-CS-SAGE-03	*Area-03 - Large 3-shaft turbofan*			
JTI-CS-SAGE-04	*Area-04 - Geared Turbofan*		**1.200.000**	
JTI-CS-2011-3-SAGE-04-017	Integration of an Acoustic Absorber into the Turbine Exit Casing (TEC)		500.000	
JTI-CS-2011-3-SAGE-04-018	Development of a Microwave Clearance Measurement System for Low Pressure Turbines		700.000	
JTI-CS-SAGE-05	*Area-05 - Turboshaft*		**0**	

Topic Description

CfP topic number	Title		
JTI-CS-2011-03-SAGE-02-009	**CROR Propeller blades**	**Start date**	T0
		End date	T0 + 18 months

1. Topic Description

Objective :

- Provide a CROR Blade definition compliant with SAGE2 Demo engine requirements for ground and flight tests
- Verify compliance of the definition with SAGE 2 requirements (by experience, analysis and/or tests)

Inputs provided to the applicant:

- Blade requirements (including de-icing capabilities)
- Aerodynamic definition (external geometry) and loads
- Interface with supporting structure (bearings and PCM interfaces)
- Supporting structure model for dynamic analyses

Activities to be performed by the applicant

- Composite blade structural design
- Blade attachment system design (Blade root and attachment device to allow variable pitch)
- Blade manufacturing tooling design, procurement and commissioning
- Manufacturing of development blades and qualification test blades
- Design and procurement of test rig hardware and instrumentation
- Performance of qualification tests:
    - Blade fatigue testing
    - Blade retention overspeed testing (static test with 2x maximal centrifugal force)
    - Blade retention fatigue testing
    - Blade 8lb bird impact test (test in rotation, or static test with representative impact conditions using applicant's facilities.)

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

The applicant has to prove professional experience in propeller blade design and manufacturing
The applicant shall have the capability to manage full scale blade manufacturing
The applicant has to demonstrate experience in impact testing on propeller blade

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
1	Blade concept validation: concept review	Preliminary design of the blade, Blade specifications, 3D Model, development and validation plan, design report.	March-2012
2	Blade detailed definition: critical design review	Blade design and drawings for manufacturing, validated by analysis or coupon tests, design report.	Jun-2012
3	Blade manufacturing review	Review of Blades manufactured for qualification tests	Dec-2012
4	Blade qualification: final review	Test results of the different qualification	Jun-2013

		tests and analyses, demonstrating the compliance of the definition with the requirements, Test report.	

4. Topic value (€)

The total value of this work package shall not exceed: **€ 4,000,000** **[four millions euro]** Please note that VAT is not applicable in the frame of the Clean Sky program.

Topic Description

CfP topic number	Title		
JTI-CS-2011-03-SAGE-02-010	**Contra-Rotating Open Rotor (CROR) Propeller barrels**	**Start date**	T0
		End date	T0 + 33 months

1. Topic Description

Definition of the components targetted in this call, hereafter referred to as "barrels":

The first set materializes the flow path after the forward rotating frame. The radius of one outer barrel is approximately 550 mm and the max length approximately 450 mm, the radius of one inner barrel is approximately 400 mm and the max length is 650 mm. The functions of the first set are:

- To channel the flow issued from the power turbine
- To prevent re-introduction of hot gas in the sumps of the propulsor
- To position the rotating nacelle.

The second set is located above the propulsor oil sump. The radius of one outer barrel is approximately 340 mm and the max length approximately 650 mm, the radius of one inner barrel is approximately 300 mm and the max length is 650 mm. The function of the second set is to channel the flow for the cooling of the oil sump.

Depending on the environment, the barrels should be in Inco718 or titanium.

Objectives :

- Provide a CROR rotating Barrels definition compliant with SAGE2 Demo engine requirements for ground and flight tests
- Verify compliance of the definition with SAGE 2 requirements (including certification requirements for rotating parts, by experience, analysis and/or tests)
- Deliver the barrels for the SAGE2 demonstrator

Inputs provided to the applicant:

- Barrels requirements - Aerodynamic definition (external geometry), loads and aero-thermal environments
- Interface with propeller rotating frames

Activities to be performed by the applicant

- Barrels design
- Barrels design validation including compliance with certification requirements for rotating parts
- Barrels manufacturing for the SAGE2 demonstrator.

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

The applicant has to prove professional experience in sheet metal parts design and manufacturing

The applicant shall have the capability to manage full scale part manufacturing

The applicant has to demonstrate experience in rotating parts design

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
1	Barrels concept validation: concept review	Preliminary design of the barrel, Barrel specifications, 3D Preliminary Model, definition of the manufacturing processes based on preliminary results; review of the development and validation plan of the proposed manufacturing processes.	Jun-2012
2	Barrels preliminary definition: Preliminary design review	Barrel design and preliminary drawings for manufacturing; presentation of numerical and experimental evidence of compliance with design and manufacturing requirements;	Dec-2012
3	Barrels Manufacturing Method decision – Critical Design Review	Barrel final design and final drawings for manufacturing.	Jun-2013
4	Barrels manufacturing review	Review of Barrels manufactured for the demonstration tests	Sept-2014

4. Topic value (€)

The total value of this work package shall not exceed:

€ 2.200.000

[two million two hundred thousand euro]

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

5. Remarks

The manufacturing costs of the barrels for the SAGE2 demonstrator will depend upon the selected method of manufacture, so the overall topic budget may be below the stated topic value.

Topic Description

CfP topic number	Title		
JTI-CS-2011-03-SAGE-04-017	**Integration of an Acoustic Absorber into the Turbine Exit Casing (TEC)**	**Start date**	*T0*
		End date	*T0+15M*

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 an integrated acoustic absorber within the TEC (Turbine Exit Casing) with a high optimization potential to allow alternate designs of environmentally friendly aero-engine components.

The objective of this CfP is the integration of an acoustic absorber into the TEC structure for demonstration in a relevant environment. This technology enables the extension of the acoustically treated area to strongly reduce the noise radiation from the core duct. This seems necessary especially with respect to increasing demands for aircraft noise reduction to meet the ACARE 2020 goals and reduce the impact of growing commercial air traffic on residents living in the vicinity of airports.

Especially in GTF applications, where the dominant contributors to engine noise (fan and jet) achieve very low noise levels due to high BPR (bypass ratio), also the additional noise sources as e.g. the LPT (Low Pressure Turbine) have to be reduced simultaneously to prevent increasing contributions. A very promising and – in general - proven technology are acoustic liners in the inlet and exhaust duct of the fan or the turbine. However, generally the available area is limited due to weight optimized design and insufficient available installation space. Therefore, the extension of the acoustically treated area into the region in between the TEC struts (both at the hub and tip walls) is a very promising concept to strongly reduce the noise contribution form the turbomachinery core section.

The acoustic potential of this technology has been proven in rig testing in the EU project VITAL (FP6) showing a noise reduction potential of 3-5 dB for a cold-flow model LPT. Accordingly, the topic of this CfP will be the validation of the integration of this technology into a relevant environment taking into account the additional boundary conditions of structural integrity, hot temperatures, containment, etc. In addition, the resulting noise reduction potential will be assessed for this specific application.

The topic manager, leader of the SAGE4 geared turbofan demonstrator, and Volvo Aero Corporation (VAC), responsible for the TEC, are jointly looking for a Partner to address the Integration of an Acoustic Absorber into the TEC. The partner will have to carry out the following tasks:

Task 1: Management

Organisation:

– The topic manager as demo leader of SAGE4 will have overall lead of the project and share all relevant data with VAC who is responsible for TEC integration of this topic.

– The partner shall nominate a team dedicated to the project and should inform the topic manager project 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 the topic manager), Technics & Quality.

Time Schedule & Work package Description:

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

– Both, the time-schedule and the work package 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 work packages, 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 the topic manager facility.

General Requirements:

– The partner shall work to a certified standard process.

Task 2: Conceptual Design

- joint concept study (with the topic manager) for integration of acoustic absorber into TEC structure
- proof of adequate absorption characteristics ($\alpha \geq 0.9$) for selected material under no flow laboratory conditions
- specification of sample hardware and sample tests to proof acoustic effectiveness and structural integrity in relevant hot stream environment. If necessary, selection of qualified/ topic manager/ certified test institute(s)
- in parallel, development of manufacturing concept for test hardware
- joint selection of design concept

Task 3 : Sample hardware testing and detailed design of test hardware

- manufacturing of sample hardware
- sample testing (acoustics, structural integrity) (if required at selected test institute)
- detailed design of test hardware based on selected design concept

Task 4 : Manufacturing of test hardware

- manufacturing of final test hardware for:
  - demonstration of fulfillment of requirements for engine application (structural integrity, material qualification, etc.)
  - demonstration in a relevant environment
- contribution to test readiness review

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

a.	Experience with hot stream acoustic liners (temperatures up to 1000 K) and related qualified materials
b.	Capability to produce complex 3d shaped acoustic liner panels
c.	Availability of automated manufacturing concept for test samples and test hardware

d.	Capability to involve a qualified test institute for sample tests
e.	Experience with requirements for engine testing

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.1	Detailed Project Plan	schedule incl. milestones, technical specification of process and equipment	T0 + 1M
D2.1	Manufacturing Concept	documentation of manufacturing concept for test hardware	T0 + 3M
D2.2	Acoustic Effectiveness	proof of acoustic effectiveness of selected material/ design concept under laboratory conditions	T0 + 6M
D3.1	Sample Hardware	provision of hardware for sample testing	T0 + 10M
D3.2	Sample Hardware Test Results	Results and analysis of sample hardware tests	T0 + 13M
D4.1	Test Hardware	provision of hardware for demonstration in a relevant environment	T0 + 15M
D4.2	Report for Test Readiness Review	demonstration of fulfilment of requirements for engine application	T0 + 15M

4. Topic value (€)

The total value of this work package shall not exceed:

€ 500.000

[five hundred thousand euro]

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

5. Remarks

Concerning test and sample hardware, the involvement of a qualified/ MTU certified test institute capable of performing representative test with respect to the material integrity as well as the acoustic effectiveness under hot stream conditions is required.

Clean Sky Joint Undertaking
JTI-CS-2011-3-SAGE-04-018

Topic Description

CfP topic number	Title		
JTI-CS-2011-03-SAGE-04-018	**Development of a Microwave Clearance Measurement System for Low Pressure Turbines**	**Start date**	*T0*
		End date	*T0+26M*

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 microwave-based systems for measurements of radial running clearances and axial rotor displacements in low pressure turbines with a high optimization potential to advance the system to suitability for series application and capability of flying.

The overall aim of this present Call for Proposal is to utilize existing knowledge and know-how of state-of-the-art microwave-based sensors and to develop the ability of the potential partner to deliver a microwave-based clearance measurement system for radial and axial shroud position measurements in low pressure turbines with shrouded blades in a quality that is adequate to incorporate the system as part of a closed-loop controlled active clearance control (ACC) system into the SAGE4 GTF Demonstrator Engine.

ACC systems are employed in low pressure turbines to optimize the running clearances between the blades and stator parts. An ACC system consists of a collector box and circumferential flow channels, which distribute cooling air in circumferential direction around the casing. The casing is cooled in the region of the internal casing hooks, which hold the outer air seals, contracts and thereby reduces the running clearances. In future closed-loop controlled ACC systems, the running clearances are continuously measured during engine operation, and this information is then used by a controller to set the cooling air mass flow. Thus, a reliable and accurate clearance measurement system is an essential component of a closed-loop controlled ACC system.

Future clearance measurement systems for series applications in closed-loop ACC systems have to be capable of the following requirements:

Requirement 1: High durability and operational reliability

Essential for the application in production aero engines is a high durability and operational reliability of the sensors in the high temperature and pressure environment of the low pressure turbine casing over at least one engine maintenance interval (typically 5000 cycles). Moreover, their functionality must not be affected by the high temperature gradients occurring between the hot gas path boundary and cooler turbine casing parts.

Requirement 2: Fulfilment of turbine casing containment requirements

The installation of the sensors in the turbine casing must fulfil the containment requirements for the casing. Additionally, the installation must enable field replaceability of the sensors.

Requirement 3: Adequate clearance measurement accuracy

The uncertainty of the radial and axial position measurement must fulfil the requirements for the closed-loop ACC system of the SAGE4 GTF demonstrator engine, that is at least ±0.02 mm and ±0.05 mm uncertainty of radial and axial position measurements, respectively.

Requirement 4: Data format and transfer

A small set of airfoil shrouds equally distributed around the circumference of one turbine stage shall be utilized as measurement targets for microwave signals. The clearance measurement system has to be capable of measuring radial and axial position data for each selected airfoil and revolution and delivering the maximum radial position and its corresponding axial position as well as the minimum and maximum axial position within intervals of 0.5 s to the controller of the closed-loop controlled ACC system. Moreover, for application in test engines the measurement system must additionally be capable of delivering measured radial and axial positions for each selected airfoil in real time to a test bed data acquisition system.

The proposal of the applicant has to include realizable values for every given requirement of the clearance measurement system to be developed and a solid approach to develop the future clearance measurement system with the given requirements.

Task 1: Management

Organisation:

– The partner shall nominate a team dedicated to the project and should inform the topic manager project 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 the topic manager), 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 the topic manager facility.

General Requirements:

– The partner shall work to a certified standard process.

Task 2: Sensor optimization for precise radial and axial position measurements

- The partner shall study and evaluate the given requirements for the clearance measurement system and optimize the sensor and the sensor installation in the turbine casing.
- The sensor optimization can be supported by numerical simulations of the microwave field in front of the sensors.

Task 3: Development of signal acquisition hardware and analysis software

- The partner shall develop signal acquisition hardware and analysis software, which fulfil the requirements. The data acquisition system must be designed for application as part of a closed-loop controlled ACC system in the demonstrator engine. Both hardware and software shall have the potential to be advanced to application in production engines and capability of flying, but this step is not part of the present proposal.

Task 4: Measurement system validation on a laboratory test stand

- The partner shall set up a laboratory test stand which is adequate for evaluation the functionality of the clearance measurement system. The test set-up must take into account all relevant details of the sensor environment in the turbine casing (geometry of blade shrouds and casing parts, relative displacements of parts during engine operation).
- The partner shall validate the functionality and accuracy of the measurement system with the laboratory test set-up.

Task 5: Testing and verification of the measurement system in the GTF demonstrator engine

- The partner shall deliver a set of optimized clearance sensors for installation in the GTF demonstrator engine and a data acquisition system including signal acquisition hardware and analysis software. The delivered measurement system shall be capable of application as part of a closed-loop controlled ACC system in the GTF demonstrator engine.
- The partner shall support an engine test campaign of the measurement system at the topic manager facilities in Munich.
- The partner shall demonstrate the functionality and accuracy of the measurement system based on the results of the engine test campaign.

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

The applicant has to be a producer of microwave-based sensors for aero engine applications.

Thus the applicant should have:

- At least several years experience in the development and production of microwave-based measurement systems, and especially for clearance measurements

- Experience in the aerospace market, ideally with developing and producing aero engine sensors for some years for companies within the aerospace industry

- ISO 9001 certification covering development, production and service of microwave-based sensors, signal acquisition hardware and analysis software

- Sufficient R&D resources and competence to enable development of the deliverables, including mechanics, electronics, software and laboratory equipment to support sensor development

- Capability to ensure reliable availabilty of microwave-based clearance measurement systems 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. simulation of microwave fields, application of microwave-based clearance sensors in aero engines or stationary gas turbines

- Ideally experience in collaborative R&D projects in the field of microwave-based clearance sensors within the aero engine industry

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Detailed Project Plan	Schedule with milestones, technical specification of measurement system	T0+1M
D2	Sensor installation concept	Description of sensor installation concept, detailed drawings, thermal and structural analysis	T0+6M
D3	Laboratory test stand available	Description of laboratory test stand and test plan	T0+6M
D4	Measurement system validation	Report on validation of measurement system on laboratory test stand	T0+9M
D5	Delivery of sensors	Delivery of a set of sensors for installation in the test engine	T0+11M
D6	Delivery of measurement system	Delivery of signal acquisition hardware and analysis software for engine test	T0+16M
D7	Engine test completed	Report on acquired data and test conditions	T0+23M
D8	Test data analysis	Post test data processing and report on performance of measurement system	T0+26M

4. Topic value (€)

The total value of this work package shall not exceed:

€ 700.000

[seven hundred thousand euro]

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

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.

Clean Sky – Smart Fixed Wing Aircraft

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	**5**	**5.650.000**	**4.237.500**
JTI-CS-SFWA-01	*Area01 – Smart Wing Technology*			
JTI-CS-SFWA-02	*Area02 - New Configuration*		**5.650.000**	
JTI-CS-2011-3-SFWA-02-019	Investigation of Bird Strike criteria for Natural Laminar Flow wings		800.000	
JTI-CS-2011-3-SFWA-02-020	Development of an automated gap filler device		550.000	
JTI-CS-2011-3-SFWA-02-021	Fixed Leading Edge Structure and Systems Demonstrator for a Business Jet laminar wing		1.500.000	
JTI-CS-2011-3-SFWA-02-022	Design and manufacturing of an innovative cryogenic wind tunnel model with motorized empennage		1.300.000	
JTI-CS-2011-3-SFWA-02-023	Development, manufacturing and testing of two different High Load Small Space Rotary Gear Types		1.500.000	
JTI-CS-SFWA-03	*Area03 – Flight Demonstrators*		**0**	

Clean Sky Joint Undertaking
JTI-CS-2011-3-SFWA-02-019

Topic Description

CfP Topic Number	Title		
JTI-CS-2011-03-SFWA-02-019	**Investigation of Bird Strike criteria for Natural Laminar Flow wings**	**Start Date**	Feb 2012
		End Date	August 2013

1. Topic Description

The SFWA programme is presently investigating the application of natural laminar flow (NLF) applied to a short range aircraft (SRA) concept to provide benefit in terms of reduced fuel burn and emissions reduction. The introduction of a laminar wing section on the aircraft and an absence of leading edge slats results in a geometry that is outside of the range of validation for existing numerical models and bird strike simulation. It may also be required to use novel materials and manufacturing techniques and innovative integration concepts for ice protection.

This CfP topic is intended to launch an activity to close the gaps in knowledge that relates to this scenario. The applicant is required to establish a new test programme for bird strike events and to use the acquired experimental data to validate numerical models that may be applied within the SRA design process.

The global objective of this CfP topic will be to establish a validated bird strike analysis capability which enables the SFWA partners to simulate bird impact on a CFRP leading edge for a natural laminar flow wing. The analysis should be capable of predicting the extent of any damage and the particular mode of any failure e.g. delamination, fracture etc.

The applicant has to set up a combined programme of test and analysis to determine the extent of damage and criteria to be applied to analyses of leading edge panels for NLF wings. The study should be concentrated on but not restricted to composite materials. Design concepts will be supplied by the SFWA partners.

The integrated leading edge solution will eventually include a wing ice protection system and possibly an erosion shield. However, in this first phase of activity it will not be necessary to include those topics in the work programme. A building block approach should be used and the analysis validated at each step. Starting from simple flat plate monolithic structures the work programme should introduce complexity towards the final objective of testing a complex monolithic CFRP leading edge section with 3D curvature, co-cured stiffening elements, a joggled butt strap joint, access panels and stiffening ribs.

The work programme conducted by the applicant should include:

1) Analysis of bird strikes on a flat and representative curved panels at various angles of impact. This should include an existing bird impact model that will be provided by the SFWA Partners.
2) Design and analysis of a supporting frame to conduct bird impact tests on flat and representative curved panels.
3) Manufacturing of an agreed number of flat and representative curved panels that include supporting stringers, subspars or other structural features.
4) Completion of impact tests at various angles (at least 3).
5) Validation of analyses and numerical models.
6) Delivery of a tool that can predict the extent of damage in a representative Composite LE geometry.

An agreed number of impact tests will be expected (at least 3) on the representative curved LE configuration and may be restricted to a specific material.

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

The applicant will be required to demonstrate knowledge of the Certification requirements relating to bird strike for both composite and metallic materials.

The applicant is encouraged to either provide their own test facility or to utilize third party facilities. All costs of tests to be included as part of this CfP topic. The final testing arrangement will however be the outcome of the negotiations.

The applicant should demonstrate a good track record with a variety of NDT techniques including high speed cameras, strain gauges, NDT scans for damage analysis and digital imagery.

The applicant may propose a bid from a Consortium in order to provide the necessary mix of experimental and analytical skills for success in this programme. Engagement with an academic partner would be acceptable.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
1	Validated analysis model and methodology	Software and Report	M18
2	Validated/correlated material models including material and fracture parameters	Report	M18
3	Test objects	Hardware	M12
4	Test report (results, validation of numerical models and analyses)	Report	M18
5	Tool capable of predicting damage in a representative 3D composite LE geometry.	Software and Report	M18

4. Topic value

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

800.000,00 €
[eight hundred thousand euros]

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
			400 000	400 000		

6. Remarks

Full details of the test and simulation programme will be derived as part of the negotiation phase with the successful applicant.

The applicant will be expected to provide all tooling required for the production of the test coupons. The details of the lay-up and material properties will be defined during the negotiation phase.

As a general guide, it is anticipated that the maximum length of proposal will be approximately 40 pages. In this context, please note also the instructions on minimum font and margin sizes and other matters in the document "Rules for Participation and Rules for Submission of Proposals and the related Evaluation, Selection and Award Procedures".

Where it is proposed to subcontract certain elements of the work to be carried out, the following conditions must be fulfilled and described in the applicant's proposal:

- Proposed subcontracts may only cover the execution of a limited part of the proposal
- Recourse to the award of subcontracts must be duly justified in the proposal having regard to the nature of the project and what is necessary for its implementation
- The applicant should indicate the tasks to be subcontracted and an estimation of the costs

All proposals shall comply with "Rules for Participation" and "Rules for Submission of Proposals" and the related "Evaluation, Selection and Award Procedures" that are available from the CORDIS website.

Topic Description

CfP Topic Number	Title		
JTI-CS-2011-03-SFWA-02-020	**Development of an automated gap filler device**	**Start Date**	June 2012
		End Date	June 2013

1. Topic Description

Natural Laminar Flow (NLF) has been identified as a key technology to contribute to the reduction of emissions for future generations of transport aircraft. A key objective for the SFWA programme is to take this technology to a Technology Readiness Level (TRL) level of 6 and a number of major flight and ground demonstrations are being coordinated to meet that objective.

A Ground Based Demonstrator (GBD) is being designed with the aim of demonstrating full systems and structural integration of the leading edge zone at full scale. It is expected that the GBD will include a joint between the composite wing box upper cover and the leading edge that might be either metallic or composite. The current baseline is a joggled joint that has been shown to meet the surface quality requirements for NLF providing it can be adequately filled.

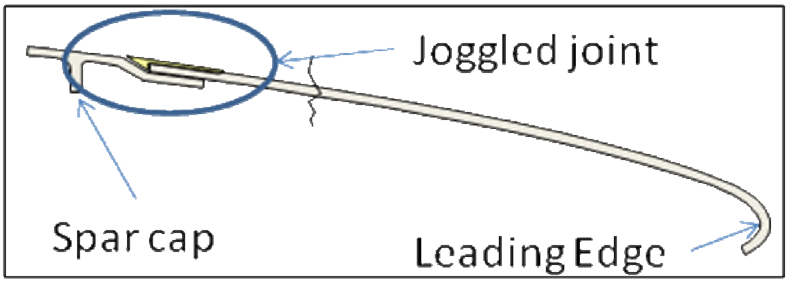


Figure 1: Joggled joint

While filled joints are in themselves not new or unique to NLF wings it is considered challenging to achieve a rapid filling of a joint that maintains the surface quality to the specified values. The global aim of this CfP is the development of a prototype tool that can apply filler into a joggled joint in a fully 3-D environment (i.e. with sweep and taper) and achieves a surface finish within NLF tolerances. In order to meet the tolerances it may be acceptable that the filler extends beyond the boundaries of the joint providing the surface quality is not compromised. It is possible that, if the tool proves successful then, further applications to more general treatment of gaps and surface discontinuities such as dents, repairs or scratches, could be considered.

The applicant has to develop a prototype of an automated gap filler device. The device should be configured to demonstrate its function on the assembled ground based demonstrator. Typical gap widths are of the order of 3mm with depths in excess of 4mm and it is required that the final step height of the filled gap be within the tolerance of +/-0.1mm. The joint may be positioned in a region of mild double curvature. The device should be capable of operation within an assembly line and also as part of remote site maintenance. Full details of the

surface requirements will be provided to the successful applicant. At this stage it should be accepted that the necessary surface requirements will be more stringent than those for a conventional wing with turbulent air flow.

The work programme will be expected to include: a background study, benchtop prototyping, software development, benchtop trials, measurements of performance, optimisation where necessary, design refinement and technical drawings and the manufacture of a final prototype for more extensive evaluation and demonstration.
At the end of the programme a detailed technical report will be published together with requirements for final compliance and marking.

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

The applicant shall demonstrate an awareness of the requirements for equipment to be used for commercial aircraft assembly either as part of a final assembly line or as a field repair capability.

The applicant should also demonstrate a good track record of innovation in the development of new manufacturing techniques and assembly solutions.

The applicant shall provide evidence of their track record in meeting tight time schedules and delivering a quality product on time and at cost.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
1	Review of potential design solutions	Report	M2
2	Results from flat plate coupon tests	Report	M6
3	Final design solution	Report	M7
4	Results from final double curved coupon tests	Report	M11
5	Prototype device	Hardware	M13

4. Topic value

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

550.000,00 €
[five hundred and fifty thousand euros]

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
			250 000	300 000		

6. Remarks

As a general guide, it is anticipated that the maximum length of proposal will be approximately 40 pages. In this context, please note also the instructions on minimum font and margin sizes and other matters in the document "Rules for Participation and Rules for Submission of Proposals and the related Evaluation, Selection and Award Procedures".

Where it is proposed to subcontract certain elements of the work to be carried out, the following conditions must be fulfilled and explained in the applicant's proposal:

- Proposed subcontracts may only cover the execution of a limited part of the proposal
- Recourse to the award of subcontracts must be duly justified in the proposal having regard to the nature of the project and what is necessary for its implementation
- The proposal should indicate the tasks to be subcontracted and an estimation of the costs

All proposals shall comply with "Rules for Participation" and "Rules for Submission of Proposals" and the related "Evaluation, Selection and Award Procedures" that are available from the CORDIS website.

Topic Description

CfP Topic Number	Title		
JTI-CS-2011-03-SFWA-02-021	**Fixed Leading Edge Structure and Systems Demonstrator for a Business Jet laminar wing**	**Start Date**	T0
		End Date	T0+24

1. Topic Description

Objective

A functional prototype of part of a full scale laminar wing equipped with an Electro-thermal Ice Protection Systems (ETIPS) has to be designed, manufactured and tested by the applicant in order to demonstrate compliance with manufacturing tolerances, weight/cost objectives, and icing requirements. The part of the wing to be represented in the prototype will be derived by the applicant to meet the demonstration and test objectives described below. Typically the front 50% of the chord of the wing profile will be required with a span wise extension of about one meter (TBC).

1. Description

Laminar wings require non turbulent airflow on a large part of the wing upper and lower surfaces, therefore the baseline laminar wing being studied for business jets is equipped with a fixed leading edge (Krüger slats are investigated as an alternate).

Laminar wings also require very stringent skin waviness tolerances, including constraints on the surface quality of for access doors and rivets.

Flight in icing conditions represents a small percentage of time in the life of an aircraft and this is not generally during cruise operation. However the wing must be perfectly clear of ice, when exiting icing conditions in order to recover full laminarity.

To achieve this goal, an alternative to state of the art hot air anti-cing systems, is Electro-thermal Ice Protection Systems (ETIPS).

Integration of ETIPS into the structure with the surface quallity requirements listed above is a novel aspect never explored before for a business jet. Achievement of the required surface quality must be demonstrated.

In addition, embedding the necessary heater mats in metallic, composite, or other matérial of the leading edge, requires a trade-off considering aircraft dispatch rate, weight, manufacturing, repair/maintenance aspects & costs.

As no runback ice is acceptable for a laminar wing, the performance of ETIPS needs to be fully demonstrated. Especially, heater mats may not only be required on the leading edge, but also the wing box may be treated for solutions defined for no runback ice.

ETIPS power consumption can be roughly estimated based on past ETIPS research projects for existing non laminar wings. However based on laminarity constraints, a system study considering various heater mat arrangement solutions, wiring definitions, weight/volumes and power consumption shall be made for a laminar wing.

Finally, demonstration of the suitability of a selected system shall be proven in an icing tunel.

Consequently this CFP topic will require:

- a structural and layout trade-off study of leading edge / front spar / wing box panels assembly and of ETIPS integration

- an ETIPS system study for a laminar wing

- realisation of a prototype representative of a chosen part of the laminar wing for demonstration of surface quality and of maintenance operations, and for an icing tunel test

- performance of an icing tunnel test

2. State of the Art

Techniques for the assembly of the leading edge, front spar and wing box covers with surface smoothness sufficient to maintain extended laminarity are currently being investigated and validated within SFWA WP 2.1. The present 'state of the art' hot air system is not the main interest because future More Electrical Business aircraft with electrical starting, as a generator sized for engine start could provide the necessary power for an ETIP system as both functions are not used simultaneously.

ETIPS has not yet proven the feaisibility of a wiring layout for moving slats as installed on recent business jet wings. For laminar wings this is not an issue as they will be fitted with a fixed leading edge.

ETIPS is presently certified on rotorcraft powered by 115 VAC.

Other electrical icing removal systems are not applicable to a laminar wing as, either they will not remove all the ice (de-icing systems) or they are based on structural deformation not compatible of the laminar wing waviness requirements.

ETIPS is therefore a candidate for a More Electrical business jet equiped with a laminar wing.

ETIPS are installed on the composite slats of the BOEING 787 with a removal solution not applicable to a business jet. This aircraft is not yet certified.

ETIPS has been studied for a classical wing of a business jet equiped with metallic slats. Only a TRL3 as been achieved.

3. Limits of Current Technology

ETIPS for moving slats of a wing of a business jet. No reliable kinematic solution for wiring routing to moving slats has been found and no endurance demonstration has been performed. Some early principles exist but they require further engineering study and endurance demonstration.

4. Requirements

Lessons learned and orientations from pre-existing studies on ETIPS integration in laminar wings will be provided to the selected partner at the start of the study.

Dassault Aviation will provide the business jet requirements for ETIPS on a laminar wing.

Dassault Aviation will perform the necessary reviews of the ETIPS system study and the structural and layout trade-off, and may complement the requirements as necessary.

Dassault Aviation will make the technical choice for the prototype from among the various possibilities that will be proposed by the CFP partners. In that respect it will define which part of the wing to realise taking into account the ETIPS structure and system study output and icing tunnel capabilities.

Dassault Aviation will follow the prototype realisation and will perform intermediate and a final reviews. The prototype final acceptance test program and report will be approved by Dassault Aviation.

Dassault Aviation will review all deliverables before final release.

Dassault Aviation will require some specific test conditions for icing tests and approve the icing tunnel test program to be written by the CFP partner. Dassault Aviation will participate to the icing tests.

4.1 ETIPS structural and layout trade-off for laminar wing (To to T0+14)

The aim of these trade-off is to classify various solutions taking as design drivers the leading edge manufacturing and maintenance cost and the weight, **with no allowed increase of cancelled missions for leading edge damage, as compared to current state of the art metallic leading edges.**

This will include impact on the wing box. For example, if heating mats or other techniques such as special painting are to be applied for no runback ice accretion.

A Laminar wing requires a low skin waviness and roughness. Doors and leading edge joints are also a challenge for the heater mat layout on a business jet wing.

Classical metallic wings with metallic leading edges or slats are tolerant to hail dammage within certain limits as defined by the aerodynamic constraints. These new leading edges shall achieve at least the same performance: this is to say, no increase in the rate of aircraft mission cancellation for hail damage.

The trade-off will therefore consider the tolerance to external damage with the associated maintenance and repair practise, for a business jet for leading edge exchange in operation.

The assembly and manufacturing of the slats shall also optimise the heat losses and provide a high efficiency.

<u>The external aspect shall be equivalent to current metallic slats for cosmetic reasons.</u>

An HIRF protection is expected, as well as a hail protection.

The leading edge partially contributes to meeting the the bird strike requirements.

The leading edge material shall not be considered as a nutriment by any birds, as they are not protected by any cover when the aircraft is parked outside.

The trade-off will therefore also consider classical metallic, composite or any other type of new leading edge material proposed by the applicant that fullfils the requirements.

This study shall also take in account the system study in an iterative process (2 or 3 iterations) which will define the heater mats chord wise and span wise arrangement and associated power densities.

4.2 ETIP System Study (To to To+14)

A ETIP system architecture definition shall be conducted for a laminar wing in order to:

- define the heater arrangement in an itérative process with the structural and system layout trade-off

- provide the system electrical consumption for a laminar wing in order to provide inputs for “more electrical génération” sizing

- provide the system definition including selected voltage, HIRF & EMI protections, failure modes, wiring definition, volumes, weights, & costs

4.3 Prototype realisation (T0+12 to To +18)

A functional, scale 1, prototype of a part of the laminar wing equipped with ETIPS (including for no runback ice), for the icing tests, shall be manufacturered to demonstrate compliance with manufacturing tolerance and weight/cost objectives, and compliance with icing requirements. The part of the wing to be represented in the prototype will be proposed by the CFP applicant considering the demonstration and test objectives; typically half of the chordwise wing profile will be required; span wise one meter (TBC) could be sufficient.

Structural and electrical controls shall be performed before the icing tests. Functional demonstration (ETIPS installation / maintenance, …) shall also be performed before the icing tests

4.4 Icing tests (To+19 to To+24)

Icing wind tunnel tests shall be conducted to prove the efficiency of the Wing Ice Protection System and fullfilment of the business aircraft requirements.

5. Innovation

Innovative solutions are expected in the domain of heater mats assembly, leading edge and wing cover manufacturing and compliance with the waviness requirements for the initial and repaired structure.

Innovative solutions are expected in the domain of slat material and heater mats technology to reduce weight and maintenance cost.

Innovative solutions are expected also in the heater mats themselves for various apsects (reliability, power density, heat transfert & heat losses, thickness of assembly, repair easiness, tolerance to damage…etc).

Some innovative solutions may not be selected for the prototype realisations for various reasons but they shall clearly appear in the trade-off with the current maturity level, and time to market provided.

6. Input

The following documents will be available for the selected partner after Specific Exchange Agreement signed

- ETIPS High Level Technical Requirements
- Laminar Wing model and icing flight case
- ERA Eco Design document **EDS Reliability Estimations**.

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

The applicant shall have knowledge of the following standards:

- MIL-STD-704F Aircraft electrical power characteristics (as a guide line)
- MIL-HDBK-217F Reliability prediction for electronic component
- DO160F Environmental conditions and test procedures for airborne equipment
- DO178B Software considerations in airborne systems and equipment certification
- DO254 Design assurance guidance for airborne electronic hardware
- CS25- Amendement 10- Appendix C Icing conditions- stratiform and cumuliform clouds
- CS 25- Amendement 10- Appendix O Icing conditions- SLD: Super Large Drooplets (Freezing drizzle, freezing rain)
- AMC 25-21G Performance and handling caracteristics in icing conditions contraints in appendix C of CS25
- AMC 25-1419 Ice protection
- CRI Fxx Special conditions to be relased by EASA in tre frame of new programs for a/c with MTOW< 60000lb

In addition the applicant shall have appropriate tools required to optimize ETIPS power consumption in icing condition and provide associated system architecture definition.

The applicant shall have good connections with industry capable to develop, industrialize and deliver similar follow-up systems to aircraft manufacturers using accepted aerospace processes such as ARP4754. In addition, the proposed project shall promote european competitiveness through a credible transition plan to industrial manufacturing in Europe.

3. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Kick-Off Meeting and report	The development plan, preliminary design of the proposal, the trade-offs studies and an updated schedule.	T0+1 month
D2	Management plan	According to organization practices, but as a minimum must cover project organisation in terms of tasks, planning and resources, document management (including the review and release process), risk management.	T0+1 month
D3	ETIPS Structural and layout Trade-off review meeting report	Intermediate and Final definition review.	T0+3, To+6, To+9, To+12 months
D4	ETIPS System architecture review meeting report	Intermediate and Final definition review.	T0+3, To+6, To+9, To+12 months
D5	ETIPS Structural and layout Trade-off final report	Draft/final	T0+12/ To+14 months
D6	ETIPS system architecture review final report	Draft/final	T0+12/ To+14 months
D7	Icing tunnel test program	Draft/ final	T0+12, T0+14

			months
D8	Prototype manufacturing review	Initial/intermediate	T0+12, T0+14, T0+16 months
D9	Risk management update		T0+9, T0+14, To+24
D10	Prototype Acceptance test program	Structural and electrical controls	T0+16 months
D11	Prototype interface control document	Detail must be sufficient to install in the icing tunnel and conduct the testing	T0+16 months
D12	First Article Inspection and Prototype Acceptance test report	Structural and electrical controls	T0+18 months
D13	Prototype deliver to the icing tunnel		No later than T0+19 months
D14	Icing tunnel test results		T0+24 months

4. Topic value

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

€ 1.500.000,00 €
[one-million-five-hundred-thousand euros]

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
			600 000 €	900 000 €		

6. Remarks

Total compliance with the technical specifications is not a strict requirement, but the specifications are a priority over any other function the applicant may propose.

Topic Description

CfP Topic Number	Title		
JTI-CS-2011-03-SFWA-02-022	**Design and manufacturing of an innovative cryogenic wind tunnel model with motorized empennage**	**Start Date**	01/05/2012
		End Date	01/05/2013

1. Topic Description

1.1 - General Description

The subject of this topic is the design and manufacturing of a full aircraft model for high-speed high-Reynolds wind tunnel test (WTT) in a cryogenic facility.

Both the configuration and testing techniques are innovative. The model will be used for an ambitious wind tunnel test of a high-speed business jet at flight Reynolds number. The evaluation of the overall gain in laminarity on a representative aircraft configuration is to be done in a cryogenic facility to ensure the potential of the technology and to consolidate the choices in terms of:

- Cruise flight design point (Mach, altitude)
- Airfoil design

This wind tunnel test is therefore the most important milestone in pushing forward the design of a future jet based on natural laminar flow technology.

A large number of steady and unsteady mesurement probes are to be integrated in the wing with special care of the final model surface quality. The design options and the ways to manufacture the wings (waviness, parts interchangeability) and to integrate the pressure probes have to be driven by the need of strong shape tolerance constraints to ensure laminarity at flight Reynolds number (about 10 millions based on the Mean Aerodynamic Chord). The applicant shall provide innovative and robust solutions to match the high level of instrumentation density and laminar shape tolerance constraints.

The model will include:

- 2 sets of wings (low sweep, high aspect ratio, laminar airfoils)
- A motorized empennage (probably U-shaped)
- A fuselage for mating the empennage and both sets of wings
- A set of flow-through nacelles and pylons representative of a twin-engine bizjet configuration

The wings will be equiped with pressure probes for buffeting and performance analysis purposes (steady and unsteady measurements).

1.2 - Model and Test description

1.2.1 - Wind-Tunnel test description

The objective of the wind tunnel campaigns is to test a highly efficient configuration studied in the scope of the Integration of Smart Wing into OAD SFWA work package. Focus is put on the design to improve environmental footprint of such an aircraft. In terms of aerodynamics, the design of the current project has been driven by:

- Efficient Low Sweep High Aspect-Ratio wing with an extensive laminar flow region on upper and lower sides and adaptive trailing edge camber. Two sets of wings are to be tested to explore different Mach cruise conditions.

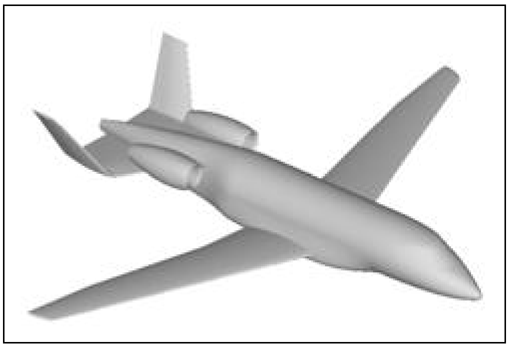


Figure 3: General View of the model preliminary design with its high aspect ratio wing

- Innovative Horizontal Tail (HT) configuration designed as engine noise shield (for both jet noise and turbomachinery noise). The stabilizing capability of the empennage at high speed and its own drag have to be evaluated during the test to consolidate the overall drag of the configuration.

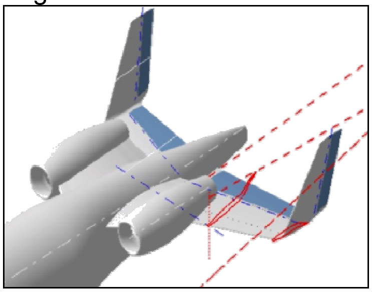


Figure 4: U-Fit Masking Tail (Jet above HT)

Therefore, the primary goal of the wind tunnel test planned with the model specified in this CfP topic is to check the efficiency and viability of design choices in terms of :

- Laminar extension on the wing at different cruise conditions (Reynolds, Mach)
- Drag decrease due to the effective laminar flow extension
- Buffet onset at different cruise flight points with laminar airfoils

The model will be tested in the (Pressure, Temperature) range below:

- Pressure from 115kPa to 300kPa
- Temperature from 110 K to 313 K

The maximum loads expected on the model are presented below (static loads only):

- Fz = + 25kN
- Fx = -100 / +900 N
- My = ± 1350N/m

These approximate loads are given only for financial estimates. Updated data will be provided with the final external shape.

1.2.2 - Model description

The model scale is approximately 1/15th, leading to a full span of about 1650mm for a length of about 1300mm. The different parts of the model are:

- 2 sets of wings with one set allowing some trailing edge interchangeability to achieve camber effects. The shape of both wings (airfoil definition, plan view, sets of trailing edge camber shapes,fairing and other control surfaces) will be specified by Dassault-Aviation to the applicant.
- a motorized empennage (probably U-shaped) with trim deflection capability. The shape (airfoil definition, plan view) will be specified by Dassault-Aviation to the applicant.
- a fuselage
- a set of nacelles/pylons mounted on the aft fuselage

1.2.2.1 - Wings

The first wing set has a 15°-20° quarter-chord line sweep with modular trailing edge and a high aspect ratio (9 to 12). Airfoil shape is driven by the pressure distribution required to achieve Natural Laminar Flow at cruise condition. Typical relative thickness for such airfoils is 9-15%.

Required modularity on this wing set is as follows:

- interchangeable trailing edges (TE) with different cambers. The trailing edge camber angles (taken at 75% chord) will be in the [-2°, +2°] range. The trailing edge will be divided in at least 3 different parts in span to enable the combination of different trailing edge cambers.

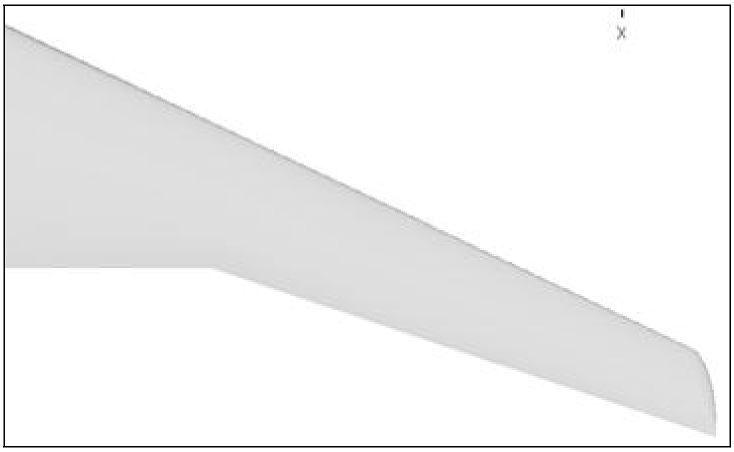


Figure 5: Generic high aspect ratio wing with laminar extension

- Removable wingtip. This will allow the model to be fitted with different wingtips/winglets if needed.

- Winglet: one winglet will be designed and manufactured for the WTT. Its external shape will be provided by Dassault-Aviation to the applicant.

The second wing set has a 20°-25° quarter-chord line sweep and a high aspect ratio (9 to 12), without any control surface nor trailing edge modularity, the other wing characteristics being the same as the first wing set.

1.2.2.2 - Empennage

The planned configuration for this model is a U-shaped tail that is composed of a horizontal plane and two symmetrically-placed vertical tips (see Figure 2).

To optimize wind tunnel testing time, a motorized empennage is requested in order to achieve discrete trim deflection angles of -2°, 0° and +2°. No control surfaces are needed on the HTP/VTP. The motorized empennage shall work at low temperature (about 110K) and high pressure (up to 300kPa).

1.2.2.3 – Pylons and nacelles

The pylons and flow-through nacelles are mounted on the aft fuselage just ahead of the empennage.

1.2.2.4 - Fuselage

The model will be mounted in the wind tunnel with a Z-sting. The fuselage will therefore include the balance integration attached to the sting. The motor for empennage trim control will be embedded inside the aft fuselage.
The fuselage is common to both wing sets but may include minor karman fairing shape modifications at the root of each wing set.

1.2.3 - Model Specification

All shape and interface definitions of the model are defined and provided by Dassault-Aviation to the applicant. Final geometry will be supplied in CATIA software definition in the Model Requirements Document to be issued in Q2 2012.

1.2.4 - Model equipment

Laminar extension will be detected on both wing sets using Temperature Sensitive Paint (TSP) techniques. Therefore, the starboard wing may be “clean” of instrumentation for TSP testing while the port wing may be equipped with pressure transducers.

To minimize the number of imperfections on the skin and avoid disturbances in laminar flow, it is important to keep the number of probes at a minimum and therefore measure steady and unsteady pressure with the same sensor. The number of pressure data locations points is around 100 for each wing set.

Exact probe locations will be specified in the Model Requirements Document to be issued in Q2 2012. The applicant shall propose a suitable way to integrate the probes (psi, Kulites) with minimal flow disturbance.

The model balance will be provided by the wind tunnel operator.

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

- The applicant shall have a large experience in designing and manufacturing Wind Tunnel Models for the aeronautical industry.
- The applicant shall comply with Dassault-Aviation procedures concerning WT model design and manufacturing. These procedures will be provided in the model requirement document to be issued in Q2 2012.
- The applicant shall have confidential agreement(s) with all partners participating in the High Speed Platform.
- The applicant shall be proficient in using Dassault Systèmes CATIA V5 Software.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
D2.1.3-D-01	Design and stress description of the model	According to detailed technical requirements	01.11.2012
D2.1.3-D-02	Complete model including instrumentation	According to detailed technical requirements	01.05.2013
D2.1.3-D-03	Geometric inspection	According to the tolerance requirements	Before 01.06.2013
D2.1.3-D-04	Instrumentation inspection	According to the technical requirements	Before 01.06.2013

4. Topic value

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

€ 1.300.000,€

[one-million-three-hundred-thousand euros]

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	0	650 000	650 000		

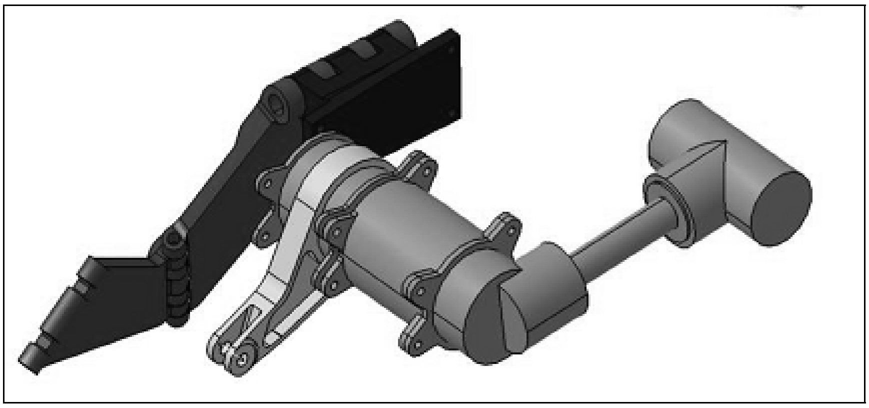
Topic Description

CfP Topic Number	Title		
JTI-CS-2011-03-SFWA-02-023	**Development, manufacturing and testing of two different High Load Small Space Rotary Gear Types for a Ground Based Systems Demonstrator**	**Start Date**	December 2011
		End Date	December 2014

1. Topic Description

For the design, manufacture, test and demonstration of an integrated Natural Laminar Flow wing leading edge a Ground Based Demonstrator (GBD) will be used. Previous CfP topics are considering a **wing ice protection system** (WIPS) and the **detailed design of the fully integrated leading edge zone**. This CfP topic is concerned with the development of the rotary gear for a Krueger high lift leading edge device for the GBD.

A 'zone' demonstrator refers to a specific region of the wing with all integrated systems e.g. the leading edge assembly. A 'feature' demonstrator refers to a specific technology that contributes to the zone under study e.g. the leading edge joint.



The applicant has to **develop, manufacture and test** rotary gears for the drive-system of selected Krueger Flap components and sub-systems to enable final assembly of the GBD. This will include but not be limited to the manufacture or procurement of:

1. 2 pcs. Rotary-Drive-Type for Krueger Device Type A; to be developed & tested
2. 2 pcs. Rotary-Drive-Type for Krueger Device Type B: to be developed & tested
3. cross shaft including its supports (might be procured)
4. 4 downdrive gearboxes & shafts (might be procured)

Basic Requirements Krueger Device Type A Rotary:

- max. Diameter less or equal 120mm.
- max. operating torque should minimum 2000 Nm
- the actuation angle 180°

Basic Requirements Krueger Device Type B Rotary:

- max. Diameter less or equal 80mm.
- max. operating torque should minimum 900 Nm
- the actuation angle 180°

Common Basic Requirements:

- the ratio should be minimum 220
- the actuation should be plug-in type

- a rectangular input to connect downdrive should be needed (to be confirmed)
- the actuator should be attached at the output end to the fixed structure by flange
- standard installation and maintenance requirements (as for other programs)
- Time for full deployment of devices : 20 sec
- ambient temperature range: from -40°C to +70°C
- aircraft certification rules

The Short Range Aircraft Conceptual Design Team within the SFWA programme will provide the successful applicant with specifications and constraints for each of these features.

It is anticipated that the GBD will be up to 4.5m in spanwise extent and may include a number of alternative kinematic solutions to cover two complete Krueger flap sections (one Type A and one Type B). Detailed Data for Manufacture has been identified within the LDA-project to the successful applicant following contract award.

In a subsequent phase, following assembly of the features into a zonal Ground Based Demonstrator within SFWA, the GBD will be used to demonstrate the required functionality and form to meet the operational requirements for an NLF wing including surface quality and Krueger functions.

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

The applicant should have a sound industrial background in development and manufacturing of drive system components in an aerospace environment.

It is preferred that the applicant should have a full ISO14001 certification.

3. Major deliverables and schedule

Del. Ref. Nr.	Title	Description (if applicable)	Due date
1	Conditions of Supply and Delivery Plan	Document	December 2011
2	Quality Assurance Plan	Document produced and agreed	March 2012
3	Interfaces Agreed; Drawings delivered	Report incl. drawings	March 2012
4	TRL4-Feeder-Review	Minutes	March 2012
5	Manufactured/Procured parts required to assemble	Hardware	March 2013
6	TRL5-Feeder-Review	Minutes	October 2013
7	Development Report	Report	October 2013
8	Finished Test of Components	Report	June 2014
9	Provision/Procurement of components	Zonal GBD Assembly	June 2014
10	Delivery & Assembly of 2pcs of Device Type A-rotaries	Zonal GBD Assembly	December 2014
11	Delivery & Assembly of 2pcs of Device Type B-rotaries	Zonal GBD Assembly	December 2014
12	Supporting drawings/instructions to enable assembly process	Document(s)	December 2014
13	Quality Inspection/Test/Deviation reports Final Report	Reports	December 2014

4. Topic value

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

1.500.000,00 €
[one million five hundred thousand euros]

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
			400 000	600 000	500 000	

6. Remarks

The assembly of the GBD will be performed by Airbus in their facilities in Bristol, UK. The successful applicant will be expected to deliver all components to that location.

As a general guide, it is anticipated that the length of proposal will be approximately 40 pages. In this context, please note also the instructions on minimum font and margin sizes and other matters in the document “Rules for Participation and Rules for Submission of Proposals and the related Evaluation, Selection and Award Procedures”.

Where it is proposed to subcontract certain elements of the work to be carried out, the following conditions must be fulfilled and explained in the applicant’s proposal :

- Proposed subcontracts may only cover the execution of a limited part of the proposal
- Recourse to the award of subcontracts must be duly justified in the proposal having regard to the nature of the project and what is necessary for its implementation
- The proposal should indicate the tasks to be subcontracted and an estimation of the costs

All proposals shall comply with “Rules for Participation” and “Rules for Submission of Proposals” and the related “Evaluation, Selection and Award Procedures” that are available from the CORDIS website.

Clean Sky Joint Undertaking
Call SP1-JTI-CS-2011-03
Systems for Green Operations

Clean Sky – Systems for Green Operations

Identification	ITD - AREA - TOPIC	topics	VALUE	MAX FUND
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	**10**	**5.690.000**	**4.267.500**
JTI-CS-SGO-01	*Area-01 - Definition of Aircraft Solutions and explotation strategies*			
JTI-CS-SGO-02	*Area-02 - Management of Aircraft Energy*		**2.400.000**	
JTI-CS-2011-3-SGO-02-014	Construction of bespoke evaluation Power Modules		250.000	
JTI-CS-2011-3-SGO-02-021	Development of key technology components for high-power density power converters for rotorcraft		250.000	
JTI-CS-2011-3-SGO-02-033	Optimisation of coating for the opeartion of power electronis with "open box" -housing in high altitude and		500.000	
JTI-CS-2011-3-SGO-02-035	Disconect device for jam tolerant linear actuators		600.000	
JTI-CS-2011-3-SGO-02-036	Design and optimisation of locally reacting acoustic material		300.000	
JTI-CS-2011-3-SGO-02-037	Feasibility study of full SiC High Integrated Power Electronic Module (HIPEM) for Aeronautic Application		500.000	
JTI-CS-SGO-03	*Area-03 - Management of Trajectory and Mission*		**2.540.000**	
JTI-CS-2011-3-SGO-03-014	Smart Operations on Ground power electronic with energy recycling system		1.390.000	
JTI-CS-2011-3-SGO-03-015	Simplified noise models for real time on-board applications		400.000	
JTI-CS-2011-3-SGO-03-016	Development of an Electronic Fligth Bag platform with integrated A-WXR and Q-AI Agents SW		750.000	
JTI-CS-SGO-04	*Area-04 - Aircraft Demonstrators*		**750.000**	
JTI-CS-2011-3-SGO-04-004	Design and manufacturing of a flight worthy intake system (scoop/NACA divergent intake)		750.000	
JTI-CS-SGO-05	*Area-05 - Aircraft-level assessment and exploitation*			

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-SGO-02-014	**Construction of bespoke evaluation Power Modules**	**End date**	December 2013
		Start date	January 2012

1. Topic Description

Background

This activity within WP2.3.1 of SGO is concerned with the design, fabrication and evaluation of planar, or sandwich, module technologies for a high-temperature power electronics module. The work package consortium will deliver a liquid-cooled, 10kW Silicon Carbide-based power converter with a 4-leg topology. A non-hermetic technology is anticipated with a nominal ambient temperature range of -60°C to +200°C. Planar/sandwich packages have no bond wires, can be cooled from both sides delivering improved thermal performance and can be optimised to give exceptionally low parasitic inductance. Although potentially attractive, the assembly of such structures has historically proved complex and costly, involving a large number of piece parts and assembly processes. Key targets of the work therefore include techniques to reduce the cost and complexity of both the substrate and assembly process. The consortium is seeking a partner who can contribute to our targets as detailed below.

2. Scope of work

1) Design study:

Prepare a fully justified mechanical and thermal design for the planar module assembly process.

2) Technologies for planar module substrate fabrication:

Establish rapid prototyping technologies to realise contact features and interconnect posts on DBC (Direct Bonded Copper) or AMB (Active Metal Brazed) substrates. The target minimum feature size is 0.3 mm x 0.3 mm with a height of at least 0.5 mm. Materials, co-planarity and compliance to suit the chosen assembly process based on design study 1) and in service requirements.

3) Cost-effective manufacturing route:

Establish a manufacturing process, employing diffusion soldering or sintering, to assemble planar modules using the substrates developed in 1) and a minimum of additional piece parts and processes. The maximum allowable assembly temperature is 300°C.

3. Type of work

1) Design study:

A mixture of thermal and mechanical simulation will be required to establish the feasibility of the proposed substrate and module assembly.

2) Technologies for sandwich substrate fabrication:

Investigate alternatives to substrate etch processes including (for example) electroplating and Direct Metal Laser Sintering (DMLS) to realise features for top contacts and interconnect posts. A significant challenge here will be maintenance of co-planarity of the layered assembly so controlled compliance is expected to be essential to ensure reproducible assembly.

2) Cost-effective manufacturing route:

Establish a low-temperature diffusion-soldering/sintering process, to achieve thin, well filled joints, with a carefully controlled bond-line thickness at bonding temperatures below 300°C. Develop a manufacturing process employing the developed bonding process that can be applied to assemble the planar module with the minimum of process operations and piece parts.

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

The successful partner will have expertise and capability in rapid prototyping, electroforming and/or other additive processes applicable to the electronics industry. Experience in the application of thermal and mechanical co-design is essential as is knowledge of physics-of-failure-based reliability design. The partner will be skilled in the application of diffusion-soldering/sintering and encapsulation to power electronic devices and modules. The partner will include a power module manufacturer equipped and resourced to provide the type and number of modules required for programme evaluation. Finally, the partner will be able to demonstrate an established track record in working with industry and academia on power module technologies for aerospace applications.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Detailed substrate and process design	Fully justified design including mechanical, thermal and life models	March 2012
D2	Substrate technology delivered	Samples of substrates to agreed specification available	July 2012
D3	Assembly technology delivered	Samples of assembled planar modules available	October 2012
D4	Prototypes	Planar modules converter assemblies delivered	September 2013

6. 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 Clean Sky program.

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-SGO-02-021	**Development of key technology components for high power-density power converters for rotorcraft swashplate actuators**	**End date**	July 2013
		Start date	March 2012

1. Topic Description

Background

This work package (WP2.3.4.2) within the JTI "Clean Sky" SGO aims to develop electro-mechanical actuation systems for rotor aircraft control surfaces. The potential benefits of moving away from an all hydraulically actuated rotorcraft are lower system weight, increased reliability and lower maintenance costs. This call for proposal (CfP) deals with the development and manufacturing of high performance power electronic converters able to drive the associated electrical machines that in turn, actuate the main rotor of a medium-sized rotorcraft. The power converters will form an integral part of the fault tolerant actuation system designed by the HEMAS (Helicopter Electro-Mechanical Actuation Systems) project team. The selected partner will work closely with the HEMAS team to develop at the component level, manufacture and test a set of power converters. Reliability/availability and weight are key to this project. The unit will be expected to operate with no forced cooling in an ambient temperature of 70C. Each power converter will be required to drive three independent, three phase motors with a peak current < 15A, be supplied from DC bus < 650V. Development of a suitable power module is therefore a major part of this call (either 9 phase output, or 3 X 3 phase modules). These power modules will be designed to withstand a high degree of thermal cycling using the minimum weight possible and should be resistant to induced failures from the other outputs. The integration of sensors and/or the use of diagnostic techniques to enable the control and detection of failures within the power circuit are also necessary.

2. Scope of work

The partner will contribute in the following ways:

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

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

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

4) Construct triple motor output drive power converters (7) for use in the HEMAS demonstration system.

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

The partner will also be responsible for:

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

3. Type of work

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

Key aspects for the design of the power modules are reliability, high temperature operation, weight. The modules should be designed for minimum electrical losses, potentially using novel semiconductor technologies such as SiC, maximum thermal conductivity through to the ambient air and with a high degree of tolerance to thermal cycling related failures. Each three phase motor output should be designed to be resistant to failures from other power modules within the converter (3X3 option) or parts of a fully integrated

(9Xoutput option) power module. Robustness to withstand vibration is also essential.

Robust, innovative, sensor / detection techniques should be developed or demonstrated so that faulty components can be taken out of use as quickly as possible to enable the continued operation of the rest of the system. Sensors to perform the control of the converter should also be integrated into the converter/power stack and where possible, into the power module.

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

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

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

The successful partner will have:

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

5. Major deliverables and schedule

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

6. 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 Clean Sky program.

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-SGO-02-033	**Optimisation of coating for the operation of power electronics with "open-box"-housing in high altitude and identification of pass and fail criteria for respective corona testing**	**End date**	30.12.2013
		Start date	03.01.2012

1. Topic Description

In the frame of Clean Sky SGO ITD, one of the project members is developing an electrically driven air system enabling both air conditioning and thermal loads management. A weight optimised power electronic is foreseen in order to drive the system. Weight saving is achieved by a so-called "open box"-concept for light weight housing which imposes new challenges to the PE (Power Electronics) design with respect to coating. The power electronic has to be protected against the impact of low pressure and condensating water (dew).

2. Scope of work

This call for proposal aims to select a partner, who will be in charge of

- the choice of coating for the PE and signal boards withstanding low pressure operation, temperature variations, humidity and vibrations,
- the elaboration of processes for the application of the coating material during the assembly phase,
- the derivation and description of pass and fail criteria for corona testing and the choice of test equipment and the testing of corona itself.

As the Power Electronic itself is developed by SGO member, a close co-operation is required in order to identify the special requirements of the PE-modules, power bus bar, drivers, signal-boards and connectors including the assembly sequence.

3. Type of work

The Partner will be responsible for the coating concept and the validation. Test conditions have to be compliant with the environmental requirements of the respective aerospace mission profiles provided by SGO member. Coating material and corona pass / fail criteria have to be identified.

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

University or SME having significant experience in:
- coating materials and processes
- corona testing

Experience on environmental constraints considered in aerospace applications will be also appreciated.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Coating concept for PE	• Report	30.06.2012
D2	Coating processes / subassembly tests	• Report	30.09.2012
D3	Corona pass/fail criteria	• Report	30.12.2012
D4	Testing of one PE including the description of the test equipment	• Report	30.12.2013

6. Topic value (€)

The total value of this work package shall not exceed:

€ 500.000

[five hundred thousand euro]

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

Topic description

CfP topic number	Title		
JTI-CS-2011-3-SGO-02-035	**Disconnect device for jam tolerant linear actuators**	**End date**	Sept-2014
		Start date	Feb- 2012

1. Topic Description

The "Systems for Green Operations – Management of Aircraft Energy" research consortium investigates new system technologies for more environmentally friendly aircraft. One approach towards this target is the "electrification" of aircraft systems under the headline of the More Electric Aircraft. This includes improvement/development of individual new electrical systems with high power/weight ratio. Envisioned benefits are:

- better energy efficiency of electrically powered systems
- increased safety due to elimination of poisonous and flammable hydraulic fluids
- reduced weight and complexity of power transmission paths, weight benefit on a/c level
- easier and reduced maintenance due to elimination of hydraulic leaks and better diagnosability.

One of these systems under consideration is the swash plate actuation system of a helicopter. Here EMAs are being developed to replace the hydraulic actuators presently used. It is the target to deliver full scale demonstration hardware, validate it in aircraft relevant environment and thus shorten significantly the time to market of the solutions developed.

The swash plate system of a helicopter provides lift, pitch and roll control. The loss of any of these control functions is classified catastrophic mandating a very robust and fault-tolerant design of the 3-degree-of-freedom swash plate actuation system. The conventional hydraulic swash plate actuation system to be replaced consists of three hydraulic linear actuators arranged around the helicopter main gear box with lower attachment points to this gearbox and upper attachment points to the static swash plate.

In the described context one peculiarity of electromechanical actuators (EMAs) compared to well established and field proven hydraulic actuators is that the mechanical jam of an electromechanical actuator has to be considered as a credible failure with a probability of occurrence of larger than 10^{-9} per flight hour. In the conventional swash plate actuation arrangement comprising three actuators, the jamming of any one of those actuators would be catastrophic. The approach to this problem investigated here, is to design jam-tolerant actuators and provide additional actuators for redundancy.

Under this call, disconnection means for electromechanical actuators (EMA) shall be developed to provide failure detection and neutralization in case of the jamming of drive train components. These disconnect devices (DDs) shall disconnect the actuator output from the main drive train elements, i.e. transform the jamming of an actuator into a free-wheel failure or in other words, allow linear motion of the actuator output with respect to its input after activation of the DD. This allows redundant actuators to take over the function of failed ones. It is one design constraint that these DDs should be placed "close" to the actuator output to be able to neutralize a high fraction of all possible failure modes that would lead to an actuator jamming (ball or roller screw jam, gearbox jam…).

In previous work an extensive study into possible implementations of disconnect devices has already been performed and an evaluation of the options is ongoing.

Quite generally the solution space can be divided into two groups of solutions:

1) Reversible and fully testable DDs

This class of solution offers the highest integrity as the DD would be fully testable in a built in test procedure and dormant failure modes can largely be excluded. However this probably comes at the cost of quite complex designs which may translate into larger envelope, weight, failure rate and cost.

Such disconnect devices could be based on commercial clutches and brakes with only limited application specific modifications. This would be beneficial to keep development risk to a manageable level. However envelope and weight might be prohibitive.

More innovative approaches involve development of customized, compact; weight optimized coupling means, DD mechanisms using the torque of the drive motor to trigger the DD (avoiding dedicated drives and power stages) or full integration of the DD within the screw drive mechanism. Other approaches that hve not yet been analyzed in detail consider application of smart materials, e.g. shape memory alloys. Reversibility/testability combined with a robust still lightweight design is expected from these innovative approaches.

2) "Single-shot" or manually reversible DDs

This class of solutions can not routinely be tested in built-in test procedures. Thus over the operational life of the DD the probability that components have failed and would not operate properly when required accumulates. However, such solutions promise to be less complex and more compact and light-weight compared to the above mentioned approach.

One example of "single-shot" DDs are pyrotechnical devices, which are widely applied in safety devices in general and offer a very fast activation and compact, relatively simple and lightweight design.

2. Scope of work

The scope of the work under this call can be structured by three work packages.

1) Study and evaluation of DD concepts

This study shall cover DD concept development (including electrical interfaces and the interfaces with the neighbouring mechanical parts) and concept evaluation against specifications provided by the caller. To provide a rough order of magnitude, the DDs shall operate under applied axial forces in the range of 20-50kN. Activation time should not exceed 20ms. Their weight should be in the lower single digit kg range. Five to ten concepts will be defined for evaluation by the caller. The applicants may also propose their preferred approaches. A hydraulic or pneumatic "infrastructure" will not be available to supply the DD. Should such solutions be considered they need to be "self-contained". The evaluation phase shall be concluded by a concept design review which will identify two concepts for implementation – one reversible DD and one "single shot" DD, the latter preferably based on pyrotechnical activation. Concept evaluation shall be prepared by the applicant(s). Concept selection shall be performed in cooperation and consultations with the caller.

The concepts shall be evaluated at least against the following criteria:

- mass, envelope
- reversibility/testability (built in test)
- coverage of possible root causes for actuator jamming
- ease of integration with the drive train
- development risk
- complexity of the design
- effort associated with DD activation (control and power electronics)

Final deliverable for this workpackage shall be a report summarizing the principal disconnect device concepts and the evaluation results.

This work package may be structured by two sub-packages, one covering the reversible DDs and one covering the single-shot designs.

2) DD detailed design

This work package covers the detailed design and required development testing for the selected DD concepts. Simulations as well as analytical calculations may be used to establish a good design confidence. This should be combined with physical testing of critical design elements or load cases where required (e.g. disconnection under maximum load). Along with this a validation test plan shall established in cooperation with the caller. Required test means shall be defined and designed/procured if not available.

The final milestone of this WP is a critical design review which will clear the designs for prototype manufacturing.

This work package may be structured by two sub-packages addressing the two selected design concepts.

3) DD manufacturing and validation testing

This workpackage covers the manufacturing and validation testing of the developed DD designs. Eight prototypes of each design shall be manufactured and delivered to the caller. Depending on the solution concept the integration of the disconnect device and the corresponding tests may already be performed in the second step of this scope of work description mentioned above. The detailed documentation of the research work will include the design trade studies, the prototype documentation and the test reports.

Final deliverable to this work package is the delivery of the validated prototypes to the caller for the integration into full-scale helicopter flight-control actuators.

This work package may be structured by two sub-packages addressing the two selected design concepts.

After completion of the project the applicant(s) shall provide assistance for the developed disconnect device(s) for additional 2 years. As far as necessary maintenance shall be performed and minor fixes/updates shall be developed. Of course, the exact scope of this “maintenance” will be defined together with the applicant(s), but it is asked to make a provision of several man-days for this part.

At the end of the project, the disconnect device will be co-owned by the applicant and the caller.

3. Type of work

The selected partner shall deliver a product development analysis; simulations and test rigs on disconnect devices with the robust functionality to convert a jammed electromechanical actuator into a free wheeling actuator.

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

The applicant(s) shall provide all the necessary resources (machines, tooling, machine elements expertise, pyrotechnic / smart materials expertise, materials, etc.) to this proposal. The selected partner will have to show the good understanding of the mechanical drive train components and should be familiar to design according to RTCA DO-160F.

Consortium including:

- Manufacturers of mechanical drive train components and/or machine elements
- Universities or research institutions with experience in the field
- Expert company in the field of pyrotechnical elements

Aerospace experience desirable.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Concepts developed and evaluated. Solution concept selected.		Jun-2012
D2	Solution concept validated by simulation and/or laboratory tests		Dec-2012
D3	Delivery of prototypes		Feb-2014
D4	Design trade studies, prototype documentation and test reports.		Jun-2014

6. Topic value (€)

The total value of this work package shall not exceed:

€ 600.000

[six hundred thousand euro]

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

Topic description

CfP topic number	Title		
JTI-CS-2011-3-SGO-02-036	**Design and optimisation of locally reacting acoustic material**	**End date**	30.09.2013
		Start date	01.12.2011

1. Topic Description

In the frame of Clean Sky SGO ITD, one of the project members is developing an electrically driven air system enabling both air conditioning and thermal loads management.

This air system is composed of an air jet pump or electrical air fan that generates noise at the aircraft skin. High frequency noise reduction is achieved using passive treatment. Interest is in developing locally reacting material that would bring further acoustic attenuation in the low and mid-frequencies.

2. Scope of work

This call for proposal aims to select a partner who has to:

- propose suitable materials to achieve acoustic attenuation in the frequency range [500-3500] Hz based on SDOF (Single Degree of Freedom) and DDOF (Dynamic Degrees Of Freedom) solutions
- perform or specify/follow acoustic test on laboratory samples of the proposed solution
- propose only solutions that can be integrated in an industrial process with small radius of curvature
- produce 2 prototypes applied to an electrical fan and a jet pump
- test in representative conditions (pressure, temperature, mass flow) will be carried out by the CFP partner

All this work will have to be done in collaboration with the SGO member in charge of the system development.

3. Type of work

The Partner will be responsible for the acoustic treatment design concept, prototype definition, and industrial process concept. Test validation criteria will be defined with the SGO member.

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

University or SME having significant experience in:

- Locally reacting acoustic material design
- Acoustic modelling/prediction of acoustic treatment performance
- Industrial process and integration knowledge
- Acoustic test capabilities

5. Major Deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Acoustic material design proposal for fan and jet pump application	Report including acoustic properties based on laboratory tests or simulation	30.03.2012
D2	Industrial process/assembly proposal	Report	30.06.2012
D3	Prototypes fabrication and testing	Prototypes available	30.12.2012
D4	Prototypes testing	Test report	30.03.2013
D5	Synthesis report	Synthesis report including recommendations for acoustic optimization in air fan and jet pump applications	30.09.2013

6. Topic value (€)

The total value of this work package shall not exceed:

€ 300.000

[three hundred thousand euro]

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

Topic description

CfP topic number	Title		
JTI-CS-2011-3-SGO-02-037	**Feasibility study of intelligent High Integrated Power Electronic Module (HIPEM) for Aeronautic Application"**	**End date**	October 2013
		Start date	October 2011

1. Topic Description

Existent power modules based on silicon semiconductor technology used for industrial application not allow to achieve drastic weight reduction and volume objectives targeted for More and All Electrical Aircraft. Compactness, efficiency, robustness and availability (fault tolerance, ..) are key drivers to be mastered for the design of next generation of power converters.

The purpose of this call for proposal (CfP) is to study the technical, industrial and economic feasibility of intelligent High Integrated Power Electronic Module (**HIPEM**) which is a key block on what the design of next generation of electronic converter like power supplies and motor controllers will be built.

This study of this **electronic subassembly** part of power converter will be based on latest technology available and extended it on future improvements (prospective view for evolving structure of HIPEM).

This CfP will help the European aeronautic partners to have better knowledge on design criteria of HIPEM and better view of next generation of this **key building block** linked to the contribution of advanced assembling material proprieties and environment constrains.

2. Scope of work

This feasibility study of intelligent high integrated Power Electronic Module (HIPEM) shall include **technical, industrial and economic parts**.

This work shall results on following activities:

a) For **technical part**, objectives consist in studying:

- ***Thermal, electrical and physical optimisation*** *of HIPEM structure designed with advanced assembling technologies,*
- ***Compatibility*** *of suggested structure with* ***aeronautic environment including CEM*** *aspects,*
- ***Integration of monolithic gate drive*** *and protective logic,*
- ***Integration of detection, protection and status indication circuits*** *for short-circuit, over temperature and under-voltage,*
- ***Integration of cooling system*** *on HIPEM.*

Manufacture of ***minimum four HIPEM demonstrators samples*** *with available advanced material including MOSFET SiC for evaluation and validation.*

b) **Industrial part** will focus on manufacturing and industrial processing study,

c) Economic part will focus on market and cost prospective of this HIPEM

The minimum expected feedback of this work for technical part is:

- Better knowledge on the design criteria and rules to built intelligent HIPEM (first generation) based on available and advanced assembling material,
- Better view on capability to integrate numerous functionality (gate drive, protective features…) of first generation of intelligent HIPEM (functions of HIPEM to be integrated with using available advanced assembling material proprieties and environment constrains)
- Better knowledge on electro thermal performances and capability of HIPEM demonstrators built during this work,
- Better view on expected improvements of first generation of first generation of HIPEM (limitation and next steps to improve design, functionality and expected new material proprieties …)

Prospective view for industrialization and economic study of first and next generation of HIPEM.

The highlight characteristics of this HIPEM are:

- Voltage Breakdown : 1200Vdc to 1700Vdc
- Output Current range : 100A to 300A,
- Operating temperature range: -55°C to 250°C or more.
- Minimum target of power density and other key technical parameters will be detailed at beginning of work.

3. Type of work

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

At T0 (assumed TBD 2011):

Kick of meeting to start project. Review of technical specification and planning to be frozen.

Task 1: (T0+2M): Clause by clause and final specification version.

Task 2: (T0+6M): Preliminary design review of technical proposal in accordance with technical specification.

Task 3: (T0+9M): Final Design Review of Technical proposal for HIPEM demonstrators.

Task 4: (T0+12M): Set of minimum quantity of five HIPEM demonstrators samples manufactured for evaluation and validation.

Task 5: (T0+18M): Test report of validated samples.

Task 6: (T0+24M): Delivery of feasibility study documentation including technical, industrial and economic parts. Progress reports will be requested every two months

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

For this study, the applicant shall satisfy following criteria:

- Good background and experience in assembling technologies, drivers functionality and Semiconductors activities,
- Insurance shall be provided to manage this work in time without delay for study and development phases.
- Adequate equipment with tools, for thermal, electrical and mechanical simulations, manufacturing process and test benches to develop and test requested demonstrators in respect with milestone of delivery,
- Available resources to execute the respective tasks should be stated in the proposal.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Requirements Analysis	Review and finalisation of module requirements specification (clause by clause) and SOW (statement of work)	T0+2
D2	Materials for Preliminary feasibility study of HIPEM 1st generation	• Technical description of concept , structure, functionality and technologies of assembling material selected. • Preliminary Design justification based on simulation results.	PDR:T0+6
D3	Materials for detailed feasibility study of HIPEM 1st generation module.	• Technical review: CDR (Critical Design Review) . Hardware design justification file. Drawing, ICD., verification and validation procedures… • Preliminary of industrial and economic study of this module will be also proposed and analysed. (Adequate documentation is needed)	CDR: T0+9
D4	Delivery of minimum 5 prototypes HIPEM 1st generation	These five modules are requested for verification and validation on converter structure (to be defined during specification and SoW definition review phase)	T0+13
D5	Test Report on validation of prototypes	Test results includes comparison with targeted objectives and recommendations to improve 1st HIPEM module.	T0+18
D6	Final Report of feasibility study of HIPEM	• This report shall deal with technical, industrial and economic aspects for 1st generation of HIPEM. • Prospective view shall be included with evolution of internal functionality and structure of HIPEM (2nd generation) based on evolution of advanced assembling materials (roadmap, …)	T0 + 24

6. Topic value (€)

The total value of this work package shall not exceed:

€ 500.000

[five hundred thousand euro]

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

Topic description

CfP topic number	Title		
JTI-CS-2011-3-SGO-03-014	**SOG power electronic with energy recycling system**	**End date**	June 2013
		Start date	December 2011

1. Topic description

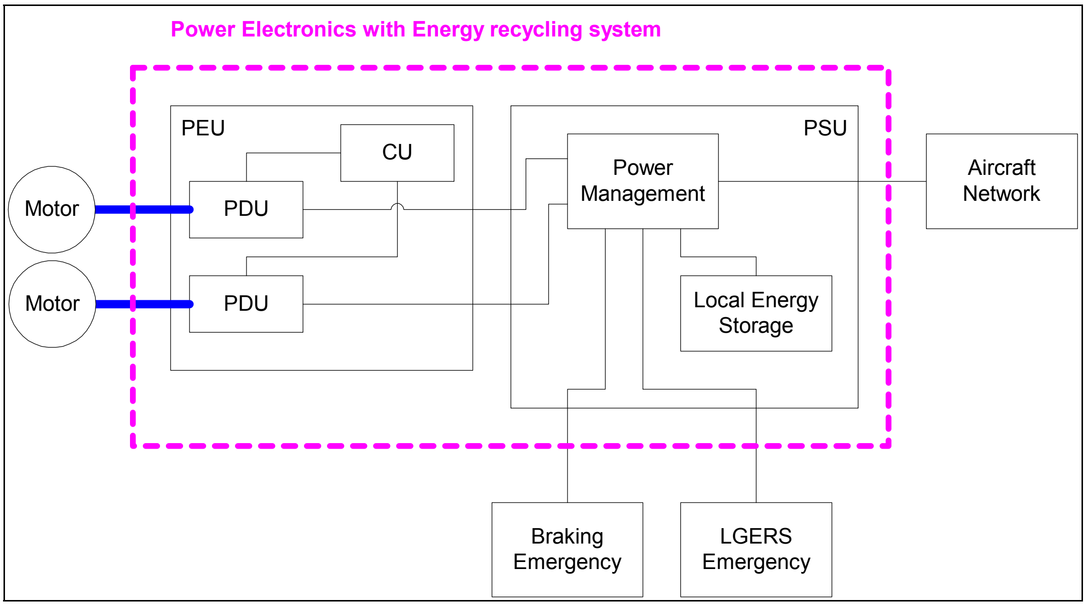
The Smart Operation on Ground (SOG) concept has appeared at the end of the 60's. It was consisting in adding an hydraulic motor within the wheel of the nose landing gear of an aircraft. This concept was not integrated on an existing aircraft, maybe due to the fact that these systems were too heavy and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

Since few years, due to significant evolution in electrical technologies, some activities have been carried out on this concept using electrical devices.

Basics functions of SOG system are forward and backward motions. Since, economic and environmental benefits can be done if aircraft braking is performed thanks to this system, a more complex and sophisticated architecture for this system shall be developed. This requires the development of a sub-system which will be able to manage regenerative power during braking phases.

The integration of this sub-system gives the opportunity, on first hand, to get extra functions such as cruise control and braking, and, on the other hand to optimised systems integration at aircraft level with, for example, emergency braking or emergency Landing Gear Extension Retraction System (LGERS) directly supplied with regenerative power stored in local storage devices.

An overview of the system is provided on the figure below.



2. Scope of work

System overview:

This system should be divided into two main parts :

- A Power Electronic Unit (PEU) which drives the wheel actuator motors
- A Power Supply Unit (PSU) which manages both power coming from the aircraft network and power provided to other aircraft systems

The PEU interfaces with the SOG wheel Actuators. It is mainly composed of Power Drive Units (including inverters, filters …) and a Control Unit (CU) which manages the wheel actuator sensors acquisition and which embedded the wheel actuator control laws. The Control Unit will also acquire orders coming from the high-level controller of the SOG system.

During acceleration phases, the PSU is providing power to the PEU in order to provide the needed motion torque to the aircraft thanks to the wheel actuators. This power may come from aircraft network or local energy storage device.

During braking phase, some regenerative power is transmitted from the Wheel Actuator Motors to the PEU and then, From the PEU to the PSU. Depending of the system status and configuration, the power may be :

- Stored in the local Energy storage device
- Transmitted to the aircraft network to supply other aircraft systems
- Burned in dedicated device (resistances, …)

During aircraft landing or landing gear Extension phases, the power embedded in the Local Energy Storage Device may be used to supply if needed the braking or the LGERS emergency systems.

Purpose of the CFP:

This CfP is aimed to design, manufacture and test the PEERS before its integration at SOG system level.

As this system shall be developed for a long term aircraft application, technologies breakthrough are allowed since they will provide significant gain in terms of performances, weight and safety.

3. Type of work

1. Design of a power electronic with energy recycling system (PEERS)
   - Architecture and technology study and choice
   - Joined integration studies with Safran(MB) & Nottingham University (plateau Phase)
   - Preliminary and detailed design
2. Manufacturing of a power electronic with energy recycling system
3. Test of the power electronic with energy recycling system
   - Acceptance Test
   - Performance Tests
4. Technical support to Safran (MB) Team during power system integration at SOG system level

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

Expert skill in power electronics design, manufacturing and test

Knowledge of aeronautical regulations and rules

Industrial applicant

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	PEERS Architecture		T0 + 5 months
D2	Conformity matrix vs. Specification		T0 + 5 months
D3	PEERS ICD	Interface Control Document	T0 + 5 months
D4	PEERS DJP	Definition Justification Plan	T0 + 5 months
D5	PEERS Components Specification		T0 + 8 months
D6	Tests programs, Acceptance Test Procedure		T0 + 12 months
D7	PEERS Prototype		T0 + 15 months
D8	DJD	Definition Justification Dossier	T0 + 17 months
D9	Tests reports		T0 + 17 months

6. Topic value (€)

The total value of this work package shall not exceed:

€ 1.390.000

[one million four hundred ninety thousand euro]

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

7. Remarks

A technical specification for the SOG power electronics with energy recycling system is provided into the reference document : DR40763 issue 1

Technical specification will be provided only if the associated 'Non-Disclosure Agreement' document is signed by the applicant.

Applicant proposal shall include prototype property transfer to the Topic Manager.

Topic Description

CfP topic number	Title		
JTI-CS-2011-3-SGO-03-015	**Simplified noise models for real time on-board applications**	**Start date**	1/2/2012
		End date	30/4/2013

1. Topic description

The Clean Sky project, Systems for Green Operations ITD, is looking for a supplier of a simplified numerical model for aircraft noise, designed for on-board applications, to become a partner of the consortium.

Joint ventures with legal personality and liability can also respond to this topic Call for Proposal.

Introduction: Clean Sky SGO MTM project objectives and context of the topic

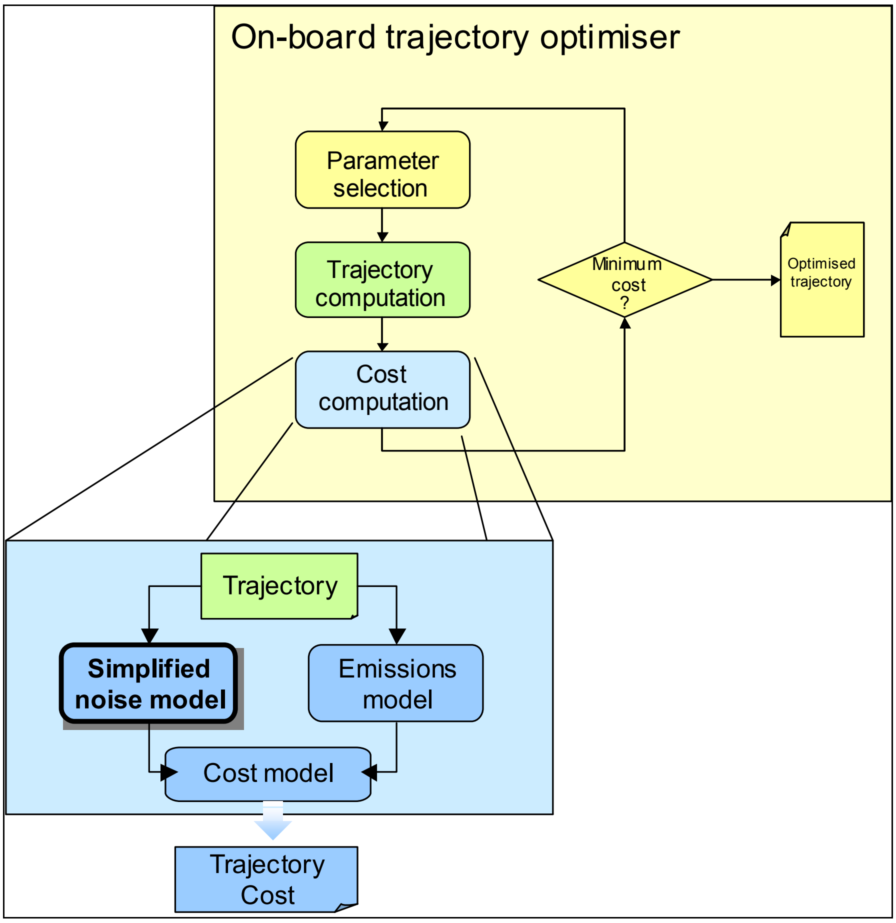
The System for Green Operations research consortium of Clean Sky aims to demonstrate substantial reductions of environmental impacts in civil commercial mainline, regional aircraft and business jet domains.

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 route. Simulations will be performed with emissions and noise models to assess the improvement of environmental performance achieved by the trajectory of the aircraft. Since the technologies and systems developed for trajectory and mission optimisation need to be inserted in the overall economical models of the airlines, which influence these operators choices, the operational "cost" of trajectory will also be assessed.

Implementation of these optimisations is foreseen either on-board, in an avionics computer, or on ground, using computing tools in a laboratory or in an airline operations centre. The activities of MTM will bring implementation prototypes of these technologies to avionics systems demonstration platforms.Context of use

Some of the technologies studied in the MTM branch of Clean Sky intend to implement and experiment aircraft trajectory optimisers aboard the aircraft, in an avionics computer. This topic looks after an 'environmental cost' noise model to be used with these trajectory optimisers as follows :



It can be deduced from this schematic that the simplified noise model will be in the inner loop of a compuation intensive optimisation process and therefore that the need cannot be fulfilled by an existing complex noise model with a reasonnable time delay.

This model will be used by a prototype of an on-board system – such as a flight management system - to compute the best 4D trajectory according to the following constributing 'costs':

- amount of noise perceived by the population surrounding an airport (which is the purpose of this topic model),
- amount of carbon dioxide produced,
- amount of nitrogen oxides produced,
- fuel consumption
- time

At this stage of the Clean Sky SGO project, this model is not expected to be installed on a real-time target computer. It will only support the development and assessment of technology prototypes. But, the product of this topic shall exhibit properties and qualities which enable a foreseen use in real-time and embedded conditions.

2. Scope of work

Description of work

The consortium wishes to enter into partnership with a supplier able to design the *model reduction* for noise emissions and propagation of an aircraft near an airport.

The end-product of this topic is a detailed specification and design for the implementation of the noise model in avionics software, thus with limited computing resources. The qualities of the model design will be tried and validated on mock-up of the model.

Design and validation of the simplified noise model

The new partner will perform the following activities concerning the noise model:

- Define the detailed technical needs in cooperation with the topic manager : use cases, driving parameters, inputs/outputs of the model, technical requirements, required performance, on-board target computing platform constraints;
- Define the detailed specifications and the design of the simplified numerical model; Justify the model reduction drivers.
- Define the methodology to build a reduced model from an existing complex noise model (possibly from measurements).
- Develop a mock-up of the numerical model;
- Identify reference aircraft trajectory tests cases and tests means to validate the model with its mock-up;
- Perform the tests of the mock-up;
- Assess the accuracy of the simplified model against a reference noise model; Analyse the difference in the results according to the model reduction purpose.
- Deliver the validated detailed specifications of the numerical model;
- Deliver the mock-up with its associated documentation, including source code.

Inputs from the CleanSky SGO ITD

The CleanSky SGO ITD will provide to the new partner the following inputs in order to perform the activities above:

- Performance requirements, operational and integration constraints, in order to design the model
- A reference noise model, requiring high end computational resources to benchmark the results of the simplified model mock-up.

Technical requirements and constraints

The general technical requirements for the the computerized numerical noise model are:

Main use cases and expected performance

The aircraft optimal trajectory and the aircraft state predictions along this trajectory are computed with regard to the noise produced during take-off or approach/landing flight phases at altitudes lower than 15.000 feet above ground level.

For given aircraft type and aircraft take-off or landing trajectory near an airport, the implementation of the noise model shall compute the effect on the ground of airframe and engine noise:

- The noise model is used by the trajectory optimiser of a flight management system prototype, in a real-time simulation environnement.
- Computation of noise is performed in a few (typically 4 to 10) discrete microphone locations around an

airport. These locations depend on the airport.

- The required response time for the noise computation of each take-off and approach/landing trajectory segment is less than 20 milliseconds (TBC) on a current generation PC. (Note that the full flight trajectory optimisation should be computed within 5 seconds)

Model content

The model shall be adaptable to different commercial aircrafts types:

- various airframes types, configurations and geometries,
- various engine types (turbofan, turboprop, propfan), size, behaviour and thrust settings.

Parametrizing the model according to the aircraft and engine should be performed through data files loaded by the model. The format and data content of theses files will be defined during the specification phase of this topic. Methods to generate those files are to be described in detail.

Validation of the model mock-up will have to be performed in several cases of aircraft / engine configurations.

As well, the model shall be adaptable to different airports configurations:

- microphones positions
- …

In the same way as aircraft types, it is assumed that the airport configuration setting is performed with loaded data files.

Model inputs

The noise model should take into account the following data inputs:

Model initialisation parameters:

- Choice of aircraft and engine types
- Choice of airport configuration

Model computation inputs:

- Aircraft trajectory along time: aircraft flight phase (take-off, landing), aircraft position (latitude, longitude, altitude), aircraft attitude (roll, pitch, heading), aircraft speed (true airspeed, ground speed),
- Aircraft configuration along time: landing gear and flaps configuration.
- Aircraft engine state along time: thrust level, …
- Atmospheric conditions around the airport (according to position): static air temperature, pressure, wind, humidity, …

This list of parameters and inputs is only a guideline. Required data, their format, resolutions, time samples or volumes, and the way they are provided to the model, are to be defined.

Several reduced parameter set can be considered by the applicant, and for each parameter set a qualification of model accuracy will be required according to each noise metric.

As required input data are assumed to widely depend on the model reduction, the detailed interface will be discussed with the topic manager during the detailed technical specification phase of the noise model.

Model outputs

The model shall compute the effect of airframe and engine noise perceived (spreading across the audible spectrum) on the ground. This effect has to be quantified according to standard noise metrics (typically those produced by INM v7.0: EPNL, SEL, LaMax…). These outputs will allow the comparison with the reference noise model provided by the CleanSky SGO ITD.

The format, resolutions, time samples or volumes required for these data are to be defined.

Implementation requirements

The model shall be designed to be compliant with real-time embedded aeronautics software constraints, such as:

- predictible algorithm convergence and computation time
- limited processing power, memory and data storage
- software architecture allowing certification (for safety)

Therefore, software architecture patterns or development process used to develop the model shall not break state-of-the-art development rules for certified avionics software (no dynamic architecture with a non-deterministic behaviour, no recursive algorithm, etc.)

The detailed model specification should be provided in a way to allow reimplementation in any high level langage. Consequently the model itself should not be tied to any computer langage specific paradigm.

For each proposed model reduction, an accuracy study versus the reference model should be performed, indicating which maximum and typical errors can be expected for each noise metric (at least EPNL, SEL, LaMax). The maximum error allowed is in the range of 1dB (reference vs. simplified) in order to be consistent with gain margins expected in Clean Sky.

The model mock-up should:

- be delivered as a software package running on Microsoft Windows XP Operating System preferably;
- run on a current generation PC, and share processing ressources with other applications;
- accept inputs and provide outputs through an API DLL and through a remote network access protocol.

Support

The mock-up of the model will be delivered to Clean Sky ITD SGO members for further analysis.

The partner organization shall have the capability to maintain this mock-up – i.e. to further adapt, optimize, and produce updated versions.

3. Type of work

Specification, design and development of a mock-up of a simplified numerical model for noise of aircrafts airframe and engines. Target applications is the aircraft trajectory optimisation in a on-board avionics systems prototype.

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

The candidate organization shall have recognized experience in numerical modelling of noise produced by aircrafts engines and airframe.

The answer to this call for proposal must include a detailed technical description of the solution with the associated evidence of the expertise and pre-existing know how.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Problem Definition (PD):	Formal Definition of the problem, completing the requirements described in the present Topic description • Required input and output data • Constraints • Expected performance • Use cases The content of this document is defined and agreed in cooperation with the topic manager or his appointed representative, through technical workshops.	15/4/2012
D2	Technical Specification document (TS)	Specification of the method for reduction of the model Specification of the resulting embedded model Rationale behind the choice of these methods	30/6/2012
D3	Software package design document (SDD)	Description of the design of embedded simplified noise model	15/9/2012
D4	Validation Test Plan (VTP)	Description of tests cases and tests means to validate the simplified noise model. The test plan shall clarify the usage domain that will be validated. This test plan shall include the acceptance tests to perform at the topic manager request.	15/9/2012
D5	Reference tests data files	.This deliverable will be accepted through an acceptance review led by the topic manager	30/10/2012
D6	Model delivery (V1):	Delivery of the software version of the model and associated documentation • source code • executable for Windows • software version description document • User Manual document (UM) • Validation Test Report (VTR), i.e. description of tests results and conclusions • (if required) Update of previous documents : TS, SDD, VTP, VTR	30/10/2012
D7	Problem report and model modification request document (PRD)	Compilation and analysis of problem reports and modification requests agreed in cooperation with the topic manager or his appointed representative.	31/1/2013
D8	Toolbox and software package delivery (V2):	Release of an updated software version of the model and associated documentation for problem fixes or evolutions • source code • executable for Windows • software version description • document • User Manual document (UM) • (if required) Update of previous documents : TS, SDD, VTP, VTR	31/3/2013
D9	Final Acceptance Test Report (ATR)	Description of the tests performed at the topic manager facility, their results and conclusions. This deliverable will be accepted through an acceptance review led by the topic manager.	30/4/2013

6. 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 Clean Sky program.

7. Remarks

Reporting

Periodic progress reports – typically monthly - will be established including the following elements:

- Description of activities performed
- Specification, design and development steps achieved
- Tests results technical reports
- Status of the next deliverables and review milestones
- Updated planning
- Action items

Meeting and review policy

- Management & progress meetings shall be periodically planned during all the project to evaluate activities progress, agree on requirements and results assessments, prepare milestones and reviews, and deal with project management issues.
- Technical meetings shall take place on SGO Topic' s manager request, in order to discuss in details specific technical points
- Review meetings shall materialize the major steps and to state if all the works and documents foreseen for these review have been performed and are acceptable. Each deliverable shall be accepted by a review meeting.

Applicants should emphasize when relevant any links or complementarity with previous projects, such as FP7-2010 Coordination Action X-NOISE EV.

Topic description

CfP topic number	Title		
JTI-CS-2011-3-SGO-03-016	**Development of an Electronic Fligth Bag platform with integrated A-WXR and Q-AI Agents SW and related interfaces with FMS to be integrated in Mission/Flight Simulator.**	**Start date**	01.01.2012
		End date	30.06.2013

1. Topic description

Reducing CO2 and NOx and mitigating external noise generated by aircraft are the major environmental goals set by ACARE, the European Technology Platform for Aeronautics & Air Transport. Task of the Clean Sky JTI is to demonstrate and validate the technology breakthroughs necessary to make major steps towards the ACARE goals for 2020. The Clean Sky Systems for Green Operations ITD, and in particular the Management of Trajectory and Mission (MTM) work package aims to demonstrate that the achievement of such results can be supported by more precise, reliable and predictable Green Trajectories, optimised for minimum noise and emission in each flight phase, including agile trajectory management in response to meteorological hazards. In this respect improvements in on-board already existing equipments can directly contribute to the achievement of overall Clean Sky objectives and provide the pilot with useful tools for optimising trajectories without decreasing safety margins.

2. Scope of work

As a possible means to help achieving the MTM objectives, an Electronic Flight Bag (EFB) capable to run trajectory optimization and simulation software, in addition to the usual functions allocated in the EFB, has been devised as an innovative equipment able to provide the pilot with useful information for the conduction of the flight. It is worth noting that the innovative character of the proposed equipment requires to be tested in an environment simulating the true flight conditions, with the aim to demonstrate its real utility for the Clean Sky objectives.

Therefore the aim of this call for proposal is the development of a custom Electronic Flight Bag of Class 2,Type B (to be confirmed) including, besides the EFB standard functions (Microsoft Windows operating system, Electronic Charts, Electronic Documents, Enhanced Vision, Flight Performance Calculations, Flight Planning support, Moving map, Synthetic Vision, Terrain display, Voice Data Communication, weather, ethernet lan connettinity, SW open, libraries, optional Traffic Surveillance, optional Video camera, others), also advanced algorithms of weather classification and artificial intelligence, to be implemented and optimized during the EFB development and to be interfaced with the EFB standard functions.

In addition a friendly user interface shall be developed to present to the pilot the results of the data processing as well as the necessary interfaces to both the simulated avionic environment and the simulated sensors (Weather Radar Processing).

The work can be divided into the following 6 functional areas to be developed under Topic manager specifications:

1. Provision of a customized Electronic Flight Bag (portable, long life battery, lan, USB, TV camera, microphone, Smart display, touchscreen, high performance video card with GPU, standard functions, databases, navigation rules, electronic documents, flight plans, aircraft performances, maps, , Electronic Charts, etc…). Also the necessary SW development tools shall be available in the selected platform. The software libraries that realize an abstraction layer to data inputs and constrains will be designed and developed. These libraries will provide access to databases (airports, maps, DTED), independently from the format in which data is saved. A Software application to receive voice commands from the pilot and recognise pilot mouth position to validate the commands should be available.
2. Provision of software of libraries and functions to support Weather Radar Postprocessing algorithms (based on topics manager specifications, and necessary documents) aimed to extract information from the output of an advanced polarimetric radar processing systems: extraction of features from the radar signal, pattern recognition, classification, radar data processing, etc
3. Provision of software libraries, functions, services and interfaces to support an application software based on Artificial Intelligence algorithms (developed inside previous Clean Sky core

activities), using both the data coming from the Advanced Weather Radar Postprocessor and database information and data available aboard a line aircraft: aircraft position, attitude and speed (from simulated Flight Management system), airport approach procedures and navigation charts (from classical EFB database), weather forecast and NOTAMs (from simulated data link), etc…

4. Design and implementation of a friendly Graphical user interface to present to the pilot the results of the data processing implemented into the EFB, ensuring that the crew can use them safely, without inducing distraction, misunderstanding or errors: suggestions of pilots derived from interviews must be taken into account. The GUI should be developped with particular care to be user friendly, customizable from the pilot and to support the pilot decisional process. All the programs installed into the EFB must ensure that the crew can use them safely, without inducing distraction misunderstandings or errors.
5. Development of the EFB software environment to integrate, interface and operate the librieries and the GUI described at point 1-4, the algoritms developed by Selex Galileo and the interfaces to exernal environment.
6. Definition and implementation of the Sw interfaces based on documents and specifications provided by the topic manager to both the simulated Advanced Weather Radar Processor and the Mission/Flight Simulator.
7. Analysis of activities to be done to certify the EFB provided. The furnisher should provide a list of the the reference standard for EFB certification and an analysis of the activities required to certify it.

Moreover, all the above described functions shall be interfaced and integrated in a consistent software architecture to be defined before the functions implementation.

Documentation: The following type of documentation (detailed in section 5) shall be delivered during the EFB development:

a) Periodic Progress Reports
b) Technical Reports
c) User Manual: A user manual will be issued for facilitating the user to operate with the developed software. In particular, details concerned GUI must be provided too.
d) Commented source codes
e) Software Description including flow charts and I/O data formats of the routines.

3. Type of work

Development of software packages implementing both Weather Radar Data Processing algorithms and Artificial Intelligence Agents, aimed to run on a custom Electronic Flight Bag and to be integrated and interfaced with the usual functions presently implemented on Class 2, Type B (to be confirmed) EFB. Particular attention shall be reserved to the Graphical User Interface and the integration into an overall Mission/Flight Simulator.

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

The applicant will demonstrate the capability to satisfy all the above listed requirements and, in particular, the ability to address the data extraction from avionic meteorological radar signals and to deal with Artificial Intelligence implementation algorithms.

A system expertise in EFB Hardware and SW function development and upgrade, expecially in SW processing is required for definition of the overall architecture and for the the integration and optimisation of the different functions.

A research team with deep skills in all mentioned scientific fields is required to cover every aspect of the project and the applicants must prove their expertise describing previous experiences in such fields.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1.n	Periodic Progress Reports	Reports on the work in progress will be issued at regular time intervals (every three-months), describing the activities performed, the obtained results and the progress of the next deliverables and review milestones.	T_0+ 3 x n months

D2	Statement of Work	Description of the different activities in which the overall programme must be divided (WBS) and for each WP the allocated resources and costs, the time schedule and the relationship with other activities. Such document must confirm the WBS presented in the proposal (see section 7) and must be agreed with SelexGalileo.	T_0+ 1 month
D3	Electronic Flight Bag (EFB) Industry Rewiew.	An overview of the Electronic Flight Bag existing on the market, with main characteristics (both HW and SW) shall be reviewed. A specific EFB will be selected and purchased with the assurance the libraries, databases and development tools be accessible for implementing he new SW and GUIs	T_0+ 4 months
D4	SW Architecture Design	Technical report describing the overall architecture of the SW to run in the EFB, and in particular the access technique to the different allocated functions and the description of I/O interface and packets to be agreed with the topic manager (ICD requirement). The document must also include the study and design of the friendly user interface to present to the pilot the results of the data processing	T_0+8 months
D6	Test Plan	Technical document describing the test to be performed and the scenarios to demonstrate the requirements	T_0+12 months
D7	Software Description Document	Describing the Software and the implemented functions w.r.t. to the requirements and the application constraints	T_0+15 months
D8	User Manual	User Manual describing how to use the implemented SW, with particular reference to the GUI, the services and available programs	T_0+18 months
D9	Test Report	Technical report on the Test performed according to the Test Plan.	T_0+18 months
D10	Tested SW code	Final software release, source code	T_0+18 months
D11	Electronic Flight Bag	Customized Electronic Flight Bag with all the operating functions described in the previous section 2. The EFB provided will belong to the customer, and will remain at SG facilities till the end of Clean Sky program (end of 2015).	T_0+18 months
D12	Certification Analysis	Report containing the list of the the reference standard for EFB certification and the analysis of the activities required to certify it	T_0+18 months

6. Topic value (€)

The total value of this work package shall not exceed:

€ 750.000

[seven hundred fifty thousand euro]

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

7. Remarks

Management policy:

- In proposal the applicant must provide a Gantt diagram of the work, dividing the required activities in clearly defined work packages and indicating for every WP time schedule, required input and delivered output, in accordance with the scheduled deliverables listed at the previous section 5.
- Management & progress meetings shall be periodically planned 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.

Topic description

CfP topic number	Title		
JTI-CS-2011-3-SGO-04-004	**Design and manufacturing of a flight worthy intake system (scoop/NACA divergent intake)**	**End date**	31.01.2014
		Start date	01.02.2012

1. Topic description

In the framework of JTI/Clean Sky, Systems for Green Operations (SGO), a flight test of a combined scoop and a divergent NACA intake is intended to supply an innovative system concept with fresh air. Since scoop intakes extent out of the aircraft, they are subjected to a harsher environment compared to flush mounted intakes. This call aims at supplementing the intake integration expertise of the SGO ITD (Integrated Technology demonstrator) member proposing this topic with the composite design and manufacturing expertise of the applicant to achieve in-flight validation of the above described intake system.

2. Scope of work

In this task, techniques should be explored to manufacture a lightweight intake system made of primarily Glas/Carbon Fibre Reinforced Plastic (GFRP/CFRP) combining a scoop and divergent NACA (National Advisory Committee for Aeronautics) intake including the following components:

* An adjustable NACA intake ramp with actuator
* Lightning protection on both intakes
* Ice protection system for the scoop intake (incl. control and monitoring sensors)
* Acoustical treatment of the scoop intake
* An erosion shield for the scoop intake/NACA intake lip
* Surrounding skin panel for interfacing to the support structure

The scoop intake will have a size of approximately 0.1 x 0.3 m².

The design of the intake system includes the following activities:

* Design of the ice protection system for the scoop
* A concept of dealing with bird strikes including an analysis or test proving this concept
* A stress report taking into account the appropriate aero, interface, inertia and shock loads
* A concept for lightning protection (test of the concept to be performed by SGO ITD member)

Although the production of the flight worthy intake does not have to be mass-producible, concepts should be studied to mass produce the intake system. The output of this task should be:

* One test specimen at appropriate production standard for lightning testing (provided to SGO ITD member)
* Two identical air intake systems fully qualified for experimental flight testing (provided to SGO ITD member)

All necessary qualification work (except for lightning testing) for the intake system to be flight worthy will be performed

3. Type of work

Applicant will develop and manufacture air system intakes and channels to be qualified for experimental flight tests.

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

The applicant must be an EASA (European Aviation Safety Agency) approved production organization (EASA Part 21G). It should have experience in manufacturing flight worthy CFRP/GFRP composite components and the integration of electro-thermal ice protection systems in such components. The applicant should have the capability to design an electro-thermal ice protection system.

5. Major deliverables and schedule

Deliverable	Title	Description (if applicable)	Due date
D1	Ice protection system design report		30.09.2013
D2	Principal design proposal (incl. Preliminary Design Review)		31.10.2013
D3	Stress report		30.11.2013
D4	Critical Design Review passed successfully		31.01.2013
D5	Manufacturing tools designed and available		30.04.2013
D6	Production of a test specimen for lightning testing completed		31.08.2013
D7	Production of two flight worthy intake systems		15.01.2014
D8	Final report		31.01.2014

6. Topic value (€)

The total value of this work package shall not exceed:

€ 750.000

[seven hundred fifty thousand euro]

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