Green Regional Aircraft

Annual Implementation Plan 2012

Annex 1b

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Abbreviations and Definitions

A/C	Aircraft
AEA	All Electrical Aircraft (one of the technology domains of the GRA ITD)
CAA	Computational Aero-Acoustics
CFD	Computational Fluid Dynamics
CfP	Call for Proposals
CSJU	Clean Sky Joint Undertaking
DESA	Deeply Embedded Smart Actuator
D&M	Design and Manufacturing
GA	Grant Agreement
GB	Governing Board
GTF	Geared Turbo Fan
HLD	High-Lift Devices
ITD	Integrated Technology Demonstrator
JTI	Joint Technology Initiative
LC&A	Load Control & Alleviation
L/E	Leading Edge
LNC	Low Noise Configuration (one of the technology domains of the GRA ITD)
LWC	Low Weight Configuration (one of the technology domains of the GRA ITD)
M	Mach number
MDO	Multi-Disciplinary Optimisation
MLG	Main Landing Gear
MTM	Mission &Trajectory Management (one of the technology domains of the GRA ITD)
NC	New Configuration (one of the technology domains of the GRA ITD)
NLF	Natural Laminar Flow
NLG	Nose Landing Gear
OR	Open-Rotor
QAS	Quality Assurance System
SACM	Smart Actuated Compliant Mechanism
SSE	Shared Simulation Environment
T/E	Trailing Edge
TF	Turbo-Fan
TP	Turbo-Prop
TRL	Technology Readiness Level
WP	Work Package
WT	Wind Tunnel
WTT	Wind Tunnel Tests
2D	Two-Dimensional
3D	Three-Dimensional

Description of work for year 2012

GRA0 – ITD Management

GRA0 - Management overview

The GRA (Green Regional Aircraft) management structure aims to ensure timely achievement of high quality technical demonstrations and to provide qualified contractual and budgetary support and coordination of the projects. It also intends to ensure that knowledge management and other innovation-related activities are coordinated at GRA level.

GRA0 - Work Programme Year 2012

The management plan document aimed at defining the management rules to be applied in the frame of the ITD "Green Regional Aircraft" for a Clean Sky continues to be updated.
Essentially, it describes: the ITD organization and how it is in relationship with other ITDs and European bodies; the way to manage the configuration and the documentation; the way to choose partners and supplier and how to manage them.
Furthermore, this Plan describes the main procedures in order to create a GRA Quality Assurance System (QAS). Finally, it's the basic reference quality and management document to be known and applied by any person contributing to the research.
This plan is applicable to the ITD GRA Program and will be used, with relevant updating, for all the phases of the program. GRA coordinator has set up a Web site with GRA members support; for some of them a contribution in kind like management instead of contributing cash to the Coordinator has been considered.
GRA Web site will be implemented to be used as secure area for submission of reports, deliverables, communication and lodging of JU documents (Steering Committee minutes, …) and as working area.
Further, the following activities will be developed:

- Coordinate ITD reporting for 2012; manage ITD interfaces to Joint Undertaking; organization and management of Steering Committees and Consortium Management Committee; administer CSJU financial contributions and maintain records and financial accounts; preparation of Annexes 1b & 2b for 2013-2016 Multiyear Annual Implementation Plan; definition in detail the description of the yearly activities for each Work Package in the Description Work; establish the 2013-2016 budget request for each members (including the CfPs budget request for years); assist the CSJU Staff member during the CfPs negotiations for aspects related to the technical implementation of the project; prepare the Annexes 1A & 1B for 2013-2016 Grant Agreement; co-ordinate the technical work through the presence of the highest level WP leaders; participation to the GB.

GRA0 - Calls for Proposals Year 2012

No CfPs will be launched during the year 2012

GRA1 – Low Weight Configuration (LWC) domain

GRA1 - LWC overview

The objective of the Green Regional Aircraft – Low Weight Configuration is to validate and demonstrate the technologies best fitting the environmental goals set for the regional aircraft entering the market in the following years.
Low weight aircraft configuration will develop the advanced solutions of composite structures where sensors are embedded and advanced materials and architectures are used so to obtain the load carrying capability plus the ancillary functions expected by the different elements of the structure at a weight significantly lower than using today technology.
The relevant technologies that, after the maturation obtained in the first years of the project, will be selected as the most appropriate in terms of benefits and costs for future regional aircraft, will then be demonstrated in full scale ground and flight tests. Demonstration will be performed in flight on appropriate test aircraft, preceded by ground tests, by replacement of a few panels (depending on selected technologies) .
Scope of the Flight Test is to obtain validation in flight for advanced structural technologies that require data acquired in an actual operating environment.
Scope of the Ground Test is to obtain validation for those advanced structural technologies that require static and fatigue data acquired using a test set-up simulating structural behaviour at full scale section level.

GRA1 - LWC Work Programme Year 2012

In 2012 the Second Down Selection of low weight technologies represents the second major event of Low Weight Domain. The manufacturing of stiffened flat large panels with different technologies selected by the First Down Selection will be completed. All panels representative of fuselage and wing architectures will be instrumented. Static and fatigue tests will be carried out. The respective test results analyses will be performed. The definition of technical solutions on fuselage/cockpit, wing and empennage of the future generic regional aircraft utilizing the selected technologies will be developed. The conceptual and stressed lay out of the structural component to be integrated on test A/C for flight demonstration will be developed. The respective test plan for demonstration in-flight will be defined. The conceptual and stressed lay-out of ground demonstrators (fuselage barrel & wing box) and the respective tooling for ground test activities will be developed. The respective test plan for demonstrations on ground will be defined. The detailed design of the structural component to be integrated on test A/C and flight tested for demonstration and of the fuselage barrel and wing box demonstrators to be tested on ground will start.

In details the following WPs will run during 2012:

- **WP1.3 GRA Enabling Technologies for LWC**

WP1.3.7 LWC Enabling hybrid Technologies.
Main activities to be performed in 2012 are addressed to the achievement of the Second Down Selection of Low Weight Technologies.
Main objectives of 2012 are:

- Completion of the manufacturing of flat stiffened panels representative of fuselage and wing architecture. Panels will be manufactured using materials (new composites and laser welded Al-Li) selected by the First Down Selection;
- Test instrumentation installation and test equipment set-up;
- Static and fatigue tests execution on large panels according to the test plan;
- Destructive and non-destructive inspection;
- Results analysis.

The best technologies selected by the Second Down Selection will be applied on ground and in-flight demonstrators.

❖ **WP1.4 LWC Application Studies for LW**

WP1.4.2 LWC Technical solution for regional A/C.
Main objective of 2012 is the definition of technical solutions on empennage, wing, fuselage/cockpit of the future generic regional aircraft considering the technologies selected in the First Down Selection and taking into account the Second Down Selection outcome of WP 1.3.7.

❖ **WP1.5 LWC Definition of Demonstration**

WP1.5.1 LWC Definition of Flight demonstration.
Main activities to be performed in the present WP are addressed to the definition of the structural item to be integrated on test A/C for the flight demonstration and the definition of the respective test plan and test lay-out.
Main objectives of 2012 are:

- Completion of the preparation of preliminary lay out of the structural component with the selected advanced technologies to be integrated on test A/C;
- Stressed lay out of the advanced structural component to be tested;
- Manufacturing plan of the advanced structural component to be tested;
- Test plan definition.

WP1.5.2 LWC Definition of Ground demonstration.
Main activities to be performed in the present WP are addressed to the definition of the structural components to be manufactured with the selected advanced technologies for ground demonstrations (fuselage barrel & wing box demonstrators) and the definition of the respective test plan and test lay-out.
Main objectives of 2012 are:

- Completion of the preparation of the general lay-out of ground demonstrators (fuselage barrel & wing box) and the respective tooling for ground test activities;
- Stressed lay-out of ground demonstrators (fuselage barrel & wing box) to be tested;
- Manufacturing plan of ground demonstrators to be tested and of the respective test rig;
- Test plan definition.

❖ **WP1.6 LWC Demonstration Preparation & Test**

WP1.6.1 Preparation of Flight Demonstration.
The present WP is aimed to the detailed design and manufacturing of the component to be tested in flight.
Main activity of 2012 is to start with the detailed design of the structural component and respective interfaces to be realized with the selected advanced technologies, integrated on test A/C and flight tested for demonstration.

WP1.6.2 Preparation of Ground Demonstration.
The present WP is aimed to the detailed design and manufacturing of the demonstrators to be tested on ground.
Main activity of 2012 is to start with the detailed design of the fuselage barrel (including skin, stringers, frames, floor grids etc.) and wing box (including skin, stringers, ribs etc.) demonstrators to be tested on ground.

GRA1 - Calls for Proposals Year 2012

In addition to the work outlined in the remainder of this Annual Implementation Plan for 2012, Calls for Proposal will be launched during the year 2012.

GRA2 – Low Noise Configuration (LNC) domain

GRA2 - LNC overview

Regional aircraft typically operate over airports located in the neighbourhood of densely populated areas, with a high frequency of taking-off and landing events and, hence, they strongly contribute to the impact of air transport on environmental noise and pollution.

Furthermore, due to the typical short range of regional aircraft whose cruising flight distance is only about 50%, the climbing performance and the empty weight of the aircraft have both a strong influence on the entire mission fuel consumption and, again, on gaseous contaminants and noise emissions over airports surrounding regions.

Therefore, in order to contribute to the achievement of the environmental goals of reducing aircraft community noise as well as gaseous emissions, the "Low Noise Configuration" project within the GRA ITD will pursue a dual purpose:

- to assess technologies aimed at reducing airframe noise which during the approach flight phase (with engine power at minimum, high-lift devices deployed and undercarriage lowered) is a major contributor to the aircraft annoyance perceived by the resident population;
- to address technology innovation toward paramount functions for a next generation, green regional aircraft:
  - highly-efficient aerodynamics to reduce fuel consumption and pollution at cruise condition;
  - wing loading control to enhance aerodynamic efficiency in all flight phases and, hence, to reduce fuel consumption and pollution over the whole mission, also allowing for steeper initial climbing, noise-abatement flight trajectories;
  - wing loading alleviation to avoid any possible loads exceeding over structural design conditions and, hence, to optimise the wing structural design for weight savings.

In order to meet the above objectives, consideration will go to enabling technologies investigated in the course of past European research programmes as well as to more advanced concepts. In particular:

- Natural Laminar Flow Wing design;
- High-Lift Devices highly-efficient / low-noise configurations involving: i) acoustic treatments (liners) and other passive solutions (e.g. flap side edge fences) to attenuate vortex flows induced noise emissions; ii) gapless leading edge architectures (drooped nose) and Krueger flap; iii) enhanced aerodynamics through optimised shaping and active flow control; iv) morphing structures;
- Loads control / alleviation concepts based on active control of conventional and non-conventional wing control movables and wing aero-elastic tailoring;
- Drag reduction through passive flow control devices to delay boundary layer transition (e.g. artificial micro-roghness) and to reduce skin friction in the turbulent flow region (e.g. micro-riblets).

The above integrated concepts and relevant technical solutions will lead to the conceptual wing design, combining conventional and advanced functions, tailored to the requirements of several configurations in the overall future scenario of the Green Regional Aircraft, that is: innovative Open Rotor and Geared Turbo Fan with rear-fuselage power plant, both aircraft integrating a NLF wing concept, Turbo-Prop and Turbo-Fan with conventional under wing engine installation.

Furthermore:

- Low-noise configurations of Main and Nose Landing Gears, based on already matured concepts (no pipes and wires installed around the strut, wheel pack fairings, etc.) and more advanced technologies (e.g. bay and doors acoustic treatments, wake vortices control), tailored to a Green Turbo-Prop high-wing Regional A/C configuration.

The LNC project work programme will develop through following phases: i) definition of requirements & architectures (WP 2.1); ii) assessment of enabling technologies (WP 2.2); iii) application studies (WP 2.3); iv) final demonstrations (WP's 2.4, 2.5 and 2.6) of selected solutions.

The down-selection process of the addressed technologies will proceed in a multi-physics view through theoretical studies, supported by advanced modelling tools, and experimental validation by wind-tunnel tests and functional / mechanical testing.

Demonstrations of wing technologies are planned to be carried out mainly through large-scale aerodynamic and aero-acoustic wind-tunnel tests on A/C configurations models and through ground demo (LC&A architecture control system). In-flight testing of some selected concepts/solutions might be also performed pending on their applicability to the GRA ITD flight demonstrator.

Demonstrations of landing gears low-noise technologies will take place through aero-acoustic full-scale WTT.

The final stage of the activity plan – analysis & final reporting (WP 2.7) - will be dealing with an overall assessment of project results as well as with guidelines/recommendations toward applications of green technologies to future products.

GRA2 - LNC Work Programme Year 2012

The activities planned over the reference project period are inherent in the "Requirements & Architectures" (WP 2.1), "Enabling Technologies" (WP 2.2), "Application Studies" (WP 2.3) and in the "Definition of Demonstration" (WP 2.4), as outlined below.

WP 2.1 - Requirements & Architectures

- Multi-disciplinary design (cruise and low-speed configuration) of a NLF wing sized to a future Geared Turbo-Fan regional A/C (130 pax, M = 0.78) with rear-fuselage engine installation. This activity will develop along the following phases:
  - 3D CFD based wing aerodynamic optimisation to achieve the best aerodynamic efficiency at key design point(s), by considering both transonic cruise and climbing performances;
  - Aero-elastic wing design coupling CFD and static/dynamic analyses to achieve the best structural efficiency (wing box minimum weight) still preserving the aerodynamic behaviour;
  - HLD design (aerodynamic shaping and settings) to optimise lift-to-drag ratio during take-off/first climb flight phases and to meet high-lift requirements at approach/landing flight conditions;
  - HLD kinematics design and preliminary definition of relevant actuation system.

WP 2.2 - Enabling Technologies

The technology development toward future OR (NLF wing), TP and TF A/C configurations which took place in 2010 and 2011 will continue throughout the reference project period. The activities inherent in the concerned technology fields are described hereinafter.

- **WP 2.2.1 - HLD highly-efficient / low-noise technologies**

  Following the assessment of mainstream technologies, dealing with passive low-noise solutions (acoustic liners, flap side edge fence), innovative hinge-less/gapless architectures (morphing T/E flap and droop nose) and active flow control (synthetic jets), as well as with more conventional L/E devices (Krueger slat), the remaining activities will be characterised by the following steps:

  a) completion of the conceptual design of a droop nose for the OR A/C NLF wing by means of MDO modelling, multi-physics virtual studies and high-fidelity functionality testing of the actuation system on mechanical prototypes;

  b) completion of the conceptual design of a morphing T/E flap (DESA and SACM concepts) as follow on of relevant testing on full-size reduced-span mechanical prototypes;

c) second and final down-selection of HLD concepts/technologies on a multi-disciplinary basis, by taking into account aerodynamic performance, acoustic impact, complexity, TRL, etc., relying on theoretical designs and on experimental results from 2D aerodynamic and aero-acoustic WT tests and from the above mentioned mechanical prototyping.

❖ **WP 2.2.5 - Loads Control & Alleviation technologies**

The development of LC&A concepts will be completed, according to the following approach:

i. aero-mechanical design of wing control movables (new rapid wing tip devices; innovative seamless surfaces for lift distribution control, new rapid T/E concepts, classical control surfaces used in a non-conventional way).

ii. assessment of concepts for loads control by means of flexible wing checked deformation (active slow shape changes of L/E and T/E to maximise wing efficiency and adaptive wing concepts).

The above technology studies will lead to the final down-selection of most suitable solutions tailored to OR, TP and TF A/C configurations, the latter developed through a project in CfP (JTI-CS-2010-5-GRA-02-014). Such solutions will be defined in terms of devices sizing and location, actuation strategy and control system architecture, by considering LC&A performance, actuation system complexity, structural/mechanical issues, reliability and so on.

❖ **WP 2.2.6 – Drag reduction technologies**

Several experimental tests will be performed on micro-riblets in order to assess the performance of these very powerful passive means in reducing skin friction drag over turbulent flow regions and, hence, to validate the CFD based simulation method developed during previous activity phases. Different kinds of experiments will be carried out, by applying micro-riblets: i) on a rotating cylinder, ii) into a pipe channel and iii) on an airfoil configuration.

❖ **WP 2.2.3 & 2.2.4 - Main and Nose Landing Gears low-noise technologies**

Following concepts will be addressed toward a future TP high-wing 5-abreast A/C configuration:

- aero-acoustic design of MLG and NLG (strut and wheel pack) by adopting both conventional solutions (aerodynamic shaping, fairings, optimised architecture reducing wires and pipes installed) and more advanced technologies (e.g. vortex disintegrators);
- LG bay (cavity) noise suppression devices (e.g. spoilers, bulkhead ramps, acoustic liners);
- LG bay doors low-noise devices (acoustic liners) and optimised design to maximise their noise shielding effect.

The conceptual design of LG low-noise configurations will rely, over the reference project period, on theoretical studies using semi-empirical methodologies, CFD/CAA numerical analyses, virtual modelling of gear actuation to account for gear integration and functionality requirements/constraints (structural issues, gear equipment interfaces, etc.). Such studies will be supported by the first part of a project to be performed under CfP (JTI-CS-2011-3-GRA-02-017) for the theoretical design and experimental validation of LG low-noise technologies.

WP 2.3 – Application Studies

The HLD architectures / technologies developed for the OR A/C NLF wing configuration and down-selected in WP 2.2.1 will be applied to the Geared Turbo-Fan A/C, which will also integrate a NLF wing concept. CFD based analysis and design to optimise the high-lift performance and the conceptual design of kinematic / actuation system will be carried out.

Similarly, the LC&A concepts and relevant technical solutions (wing movables sizing, actuation logic, control system architecture) sized to the OR A/C NLF wing configuration, as down-selected in WP

2.2.5, will be applied to the Geared Turbo-Fan A/C. Relevant initial studies will be carried out during the reference project period.

WP 2.4 - Definition of Demonstrations

Several activities will be performed with respect to the CfP (JTI-CS-2012-1-GRA-02-020) dealing with D&M and testing of a large-scale innovative WT model of the NLF wing (GTF A/C), also integrating T/E control movable devices, to demonstrate laminar wing design and LC&A performance at high-speed conditions.

In particular, apart from the management of the negotiation phase, the initial part of the project to be undertaken by the winner applicant will be supported through the release of a detailed specification of test model and of test requirements.

GRA2 - Calls for Proposals Year 2012

In addition to the work outlined in the remainder of this Annual Implementation Plan for 2012, Calls for Proposal will be launched during the year 2012.

GRA3 – All Electrical Aircraft (AEA) domain

GRA3 - AEA overview

GRA3 domain is mainly focused on studies, verification and validation activities aimed at demonstrating the feasibility of All Electrical Aircraft (AEA) approch for the Future Regional Aircraft.
The removal of hydraulic fluid will further contribute to achieve the goal of an environmental friendly regional aircraft.
To achieve such objectives, innovative technologies for on-board systems (e.g., electrical and electronic technologies for generation, distribution and control, electrical air conditioning and pressurization, de-ice protection, electromechanical actuation for flight controls/landing gears, …), relevant for the implementation of the All-Electric Aircraft (AEA) concept, shall be extensively investigated and validated. Furthermore, advanced functions for the Management of Aircraft Energy shall be developed and demonstrated, such as the Electrical Energy Management which is the control of aircraft electrical loads - optimizing weight, volume and consumption - while taking care of power transients by "smoothing" non essential or non critical loads for that operative flight or operative phase.

GRA AEA will demonstrate, up to flight demo, architectures and components fully representative of aircraft integration issues for next generation Regional Aircraft.

GRA3 - AEA Work Programme Year 2012

During 2012 the GRA3 will continue analysis and application studies for on-board systems affected by All Electric approach either for Future Regional Aircraft and for the In-Flight Demonstrator including implementation analysis and integration of Energy Management Functional logics.
It will be completed the feasibility and the definition of the modifications to be implemented on the A/C demonstrator in order to integrate and to test in flight the innovative technologies for selected on-board systems: Electrical Environmental Control System (E-ECS), Electrical Energy Management (E-EM), Hybrid Wing Ice protection System (H-WIPS). In the second half of the year it will start the design and development of the all A/C demo modifications including FTI introduction and the modification of A/C Electrical Power Generation for Demo purposes.
In parallel will start the preparation of the Verification plan for In flight demonstration and will progress the development of the Shared Simulation Environment (SSE) to be used for the assessment and the optimisation of the Energy Management logics, this including the management of two associated Call for Proposal (CfP).
It will managed the final phase of 2010 CfP activities concerning the "feasibility studies of power controller for different types of electrical motors within an Energy Management architecture". Furthermore it will be supported and monitored the 2011 CfP activities concerning Development and manufacturing of innovative equipment for Electrical Eenergy Management in flight demo as well as for the development and manufacturing of advanced Electromechanical Actuation and associated bench test for Flight Control System and Landing Gear extension and retraction.
Finally, Call for Proposals/Call for Tenders will be prepared and launched aiming to develop and manufactur innovative FTI, equipment and parts for the "preparation of Flight Demonstration"

In details the following WPs will run during 2012:

❖ WP 3.2 AEA technologies for systems (methods & tools):

The WP started on 1st December 2008.
The WP aims at the selection and adaptation of tools and methods suitable to the Energy Management design and simulation. The main objective is to develop a Shared Simulation Environment (SSE) to be used for the assessment and the optimisation of the Energy Management logics.

The activities for the year 2012 will continue the ones carried out during the year 2011, mainly addressing the following points:

- SSE development
  - Implementation of SSE according to the requirements developed in 2010.
  - Integration of Level 1 *(Architectural Level)* and Level 2 *(Functional Level)* and Level 3 *(Behavioural Level)* models into the SSE
  - .
  - Management of 2011 CfP JTI-CS-2011-3-GRA-03-007 "*Improvement of numerical models for JTI/GRA Shared Simulation Environment*"

- Development of systems models of regional aircraft
  - Complete implementation of Level 1 and Level 2 and Level 3 simulation models
  - Management of the final phases of 2010 CfP JTI-CS-2010-4-GRA-03-003 "*Development of numerical models of aircraft systems to be used within the JTI/GRA Shared Simulation Environment*"

- Development of Thermal Architecture Model of regional aircraft
  - Complete the development of Level 3 simulation Cabin thermal model

❖ WP3.3.1 Future Aircraft Configuration for AEA :

The WP started on 1st November 2009 to last about 59 months.
The activities for the year 2012 will continue the ones carried out during the year 2011, mainly addressing the following points:

- Analysis of function and performance of on board systems for an All Electrical future regional A/C. Activities based on the input coming from the WP 3.1.1 and WP 3.1.2 as well as data from GRA New Configuration Domain concerning A/C configuration definition.

- Supporting and monitoring of the 2011 CfP activities concerning Development and manufacturing of innovative equipment of advanced Electromechanical Actuation and associated bench test for Flight Control System and Landing Gear extension and retraction.

- Monitoring and validation of the results of 2010 CfP activities concerning the "feasibility studies of power controller for different types of electrical motors within an Energy Management architecture".

- Implementation, analysis and Integration of Energy Management Functional logics for Future Regional Aircraft

❖ WP3.3.2 Demonstrator Configuration for AEA:

The WP started at the end of 2010 to last about 33 months.

The activities for the year 2012 will continue the ones carried out during the year 2011, mainly addressing the following points:

- Completion of the feasibility studies for Introduction of modifications to be implemented on the A/C demonstrator

- Analysis of functions and performance of on-board systems interested to in-flight demonstration, with definition of the modifications to be implemented on the A/C demonstrator in order to integrate and to test in flight the innovative technologies for selected on-board systems:
  - Electrical Environmental Control System (E-ECS),
  - Electrical Energy Management (E-EM),
  - Hybrid Wing Ice protection System (H-WIPS).

- Definition of the above A/C demo modifications including also FTI introduction and the modification of A/C Electrical Power Generation for Demo purposes.

- Implementation analysis and integration of Energy Management Functional logics for ground and in flight demo

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❖ WP3.4 AEA Definition of Demonstration

WP will start at the beginning of 2012 and is expected to last 14 months. In the 2012 the activity concerns the start of Verification plan for In flight demonstration preparation

❖ WP 3.5.1 Preparation of Flight demonstrator for AEA:

The WP will effectively start in the middle of 2012 to last about 25 months even if some activities were already conducted in 2011 in order to prepare and launch some CfP aiming to design, develop and manufactur innovative FTI, equipment and parts for the for the modifications to be implemented on the A/C demo
The activities for the year 2012 will address the following points:

- Start of design of systems and structural modification and parts for the modifications to be implemented on the A/C demonstrator:
  - Electrical Environmental Control System (E-ECS),
  - Electrical Energy Management (E-EM),
  - Hybrid Wing Ice protection System (H-WIPS),
  - New Electrical Power Generation for Demo Supply Channel,
  - EMA's Loads and associated Bench Test introduction on-board.
  - Innovative FTI

- Preparing and launch of Call for Proposals/Call for Tender aiming to develop and manufacturE the innovative FTI.

- Support and monitoring of the 2011 CfP activities concerning Development and manufacturing of innovative equipment to be introduced on A/C demo such as:
  - Electrical Ennergy Management in flight demo Control Consolle and Electrical Power Center
  - Programmable Electrical Loads and advanced Power Supply Modulation for Electrical Energy Management testing in Flight Demo

GRA3 - Calls for Proposals Year 2012

In addition to the work outlined in the remainder of this Annual Implementation Plan for 2012, Calls for Proposal will be launched during the year 2012.

GRA4 - Mission and Trajectory Management (MTM) domain

GRA4 - MTM overview

The activities regarding Mission and Trajectory Management (MTM) are performed in GRA ITD in tight cooperation with Systems for Green Operations (SGO) ITD.
The over-all idea is that GRA ITD define Regional aircraft high level requirements and MTM peculiar functionalities. These inputs are provided to SGO ITD in order to be taken into account during technology studies. The candidate technologies will be assessed and down-selected in SGO ITD and further development for the regional applications in GRA ITD. When ready the technologies will be integrated in a Regional aircraft flight simulator. Finally, the simulator will run tests in order to assess the environmental benefits deriving from new green technologies.
In Clean Sky time-frame Alenia will participate to SGO activities such as regional a/c trajectory definition, support to optimisation tool development and technology studies. During trajectory studies inputs coming from SESAR will be taken into account.

GRA4 - MTM Work Programme Year 2012

The activities planned for 2012 are:

- A/C high level requirements for MTM (WP 4.1.1) – started in 2008
- Prototyping Tool for MTM functions (WP 4.3) – started in 2011

WP4.1.1 A/C high level requirements for MTM:

- MTM functional requirements (2nd phase)
- Operational scenario (2nd phase)

The first release of the above documents was produced in 2010, in 2012 the preparation of updated version will continue, covering possible input coming from SESAR:

In these activities Alenia Aeronautica and Thales are involved.

WP4.1.2 Requirements for MTM demonstration:
The aim of this WP is to define the requirements for MTM demonstration, in terms of demonstration scenarios. The output of these tasks will be used during test cases elaboration (GRA 4.4).

- Scenarios analysis (2nd phase)

in 2012 the preparation of updated version will continue, covering possible input coming from SESAR:

In these activities Alenia Aeronautica, Thales and Air Green are involved.

WP4.3 Prototyping Tool for MTM functions:
In 2012 the aim of this WP is:

- to start the upgrade of the basic version of GRA flight simulator
- to upgrade ATM scenario model
- to finalize the development of the first release of Green FMS
- to start the development of a second release of Green FMS

In these activities Alenia Aeronautica, AleniaSIA, Thales and UniBO are involved.

GRA4 - Calls for Proposals Year 2012

No CfP are currently planned for year 2012.

GRA5 – New Configuration (NC) domain

GRA5 - NC overview

Regional aircraft high level requirements, including power-plant, will be defined for two different seats class: 90 and 130.
In order to demonstrate the environmental improvements that the GRA ITD will be able to reach, it's necessary to compare the Reference A/C, based on the technology of the 2000 year, with the Green A/C that will integrate the technologies development obtained in the others GRA domains (LWC, LNC, AEA and MTM).
For this reason, in the NC domain the sizing of the following A/Cs will be developed:

- Two Reference A/C
  - 90 pax with TurboProp engine
  - 130 pax with TurboFan engine

- Two Green Concepts
  - 90 pax with TurboProp Engine,
  - 130 pax with Advanced-TurboFan, Geared TurboFan and Open Rotor Engines.

NC effort's will be concentrate, in particular, on the classification of all possible architectures matched with all compatible and innovative power-plants enabling the integration.
Trade-off studies will be performed for the assessment of the aircraft general architectures and performance that are the "best fit" with respect to the GRA environmental targets and the technologies developed in others GRA technology domain. NC will provide to Technology Evaluator two A/C Simulation Models of the GRA ITD (GRASM), for the Reference A/C and for the Green Concept in order to perform the Clean Sky Assessment relevant for the environmental (noise and emissions) impacts.
The integrated technologies developed will be tested by means a specific Aerodynamic and Aeroacoustic WT campaign, in particular including the development of an aeroacoustic integration of the Open Rotor Engine in the 130 Pax concept. Final demonstration will consist of a large scale Wind Tunnel Test that will assess the performance of the 130 pax Green concept configuration in terms of noise and aerodynamic characteristics.

GRA5 - NC Work Programme Year 2012

2012 GRA NC activities will be focused on the development of the Turboprop, Turbofan and Open Rotor configurations. Main activities are:

- Update the green aircraft/powerplant requirements that will be utilized for the Loop 3;
- Completion of the Loop 2 activities concerning the Green A/C Preliminary Sizing considering all technological improvement coming from the other GRA ITD Technical domains (LWC, LNC and AEA)
- Optimize the Powerplant/Airframe integration during the 2nd Loop activities;
- Perform Trade-Off studies in order to compare the integration of the different Powerplants for each configuration, from environmental point-of-view.

In details the following WPs will run during 2012:

❖ **WP5.1 NC A/C High Level Requirement**

WP 5.1.1 High level requirements for aircraft: This WP concerns the Top Level Aircraft Requirements and environmental targets definition for future Green Regional Aircraft (Turboprop, Turbofan and Open Rotor). Main topic is, starting from the final results of new market survey (Call for Proposal JTI-CS-2011-

1-GRA-05-006), to provide the third and final set of High Level Aircraft Requirement related to future operational scenarios (new ATM systems, rules, ICAO emission management rules, maintenance, ground operations, end of life issues, etc.) of relevance to regional aircraft and their operators peculiar features. During the last quarter (Q4) of 2012 year the final TLAR will be specified.

WP 5.1.2 High level requirements for power-plants: This WP concerns the specifications for the engine power-plant employing the general Top level Aircrafts Requirements released from the previous WP5.1.1. Main objective is to update/redefine Green high level powerplant requirements for the Loop 3 (thrust requirement on specifications point, power extraction, emissions and acoustic requirements, mass and geometry limiters) for the three engine configurations studied during the previous loop (Turboprop, Turbofan and Open Rotor). Final requirements for Turboprop engine to install on the future Green Regional Aircraft configuration will be also specified. During 2012 year the Loop 2 activities of the Advance Turbofan and Open Rotor will be completed. The relative TLAR will be issued in the 2013 year.

- **WP 5.2 NC A/C Level Architectures**

WP 5.2.1 Aircraft general architectures and performance: This WP concerns the preliminary green aircraft general architecture and performance studies. For each Green aircraft, the best layout configuration will be selected accomplishing the requirements defined in WP 5.1.1 & 5.1.2. Main system and structure architectures will be defined for such configurations.
The main activity in the 2012 year is the completion of the 2nd Loop of the Green Aircraft Preliminary Sizing that will generate the 2nd Green aircraft definition document, taking into account the development of the More Electric Aircraft Systems architectures vs AEA concept studies, the Aerodynamic aspects (Wing design and HLD studies) and the Preliminary Structural layout definition according with the new materials improvements.

Another task is devoted to Aircraft Simulation Models updating to send and supply the Technology Evaluator (TE) for the global assessment of green features of such A/C's.

Further activities will be focused on innovative Preliminary design of Regional Open Rotor A/C rear Fuselage (integration of Fuselage, Empennages and power-plant) in order to minimize weight, to maximize aerodynamic efficiency and the best engine noise shielding.

Another task will be oriented to investigate advanced prop fan (CROR) propeller characteristics and its associated local impact on aerodynamic, acoustic and vibration environments of A/C configuration in order to catch certification rules.

WP 5.2.2 GRA Power plant architectures: This WP concerns the definition of architectures, performances, main characteristics and relevant systems of three different green engines (Turboprop, Advanced Turbofan and Pusher Open Rotor) in order to size the Green aircrafts configurations. Engines Manufacturer will prepare a detailed technological description in order to highlight the main new technologies considered for the new green concept with respect to 2000 year. Besides they will supply also Alenia in the second issue of Aircraft Model Simulation preparation to send to Technology Evaluation. At end of the 2012 year, the third loop of engine data updating will start.

- **WP 5.3 Powerplant airframe integration for NC**

This WP is devoted to optimize the Powerplant/Airframe integration for all Green aircrafts configurations studied. The optimization aims to improve green features (noise and emissions) taking into consideration aerodynamics and structures constraints. The activities of the 2012 year will be focused on the 2nd Loop of integration studies for Green Turboprop, Turbofan and Open Rotor configurations.

- **WP 5.4 Definition of demonstration for NC**

WP 5.4.1 NC technologies selection for the demonstrations: This WP is devoted to select technologies coming from other GRA domains and available from the NC studies, to calibrate the trade off studies in order to single out the most promising configuration and to compare different Green A/C configurations available from architecture/integration studies. Emphasis will be given to green features (emission and noise). Starting from main results of the 2nd Loop of Preliminary Sizing, 2012 year activities will be characterized by trade-off studies, highlighting pros and cons in terms of green features.

GRA5 - Calls for Proposals Year 2012

In addition to the work outlined in the remainder of this Annual Implementation Plan for 2012, Calls for Proposal will be launched during the year 2012.