European Commission
Research Directorates

Green Regional Aircraft

Annual Implementation Plan 2009

Annex 1b

Table of content

Description of work for year 2009

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 2009

The management plan document is aimed at defining the management rules to be applied in the frame of the ITD "Green Regional Aircraft" for the Clean Sky.
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. Following activities will be developed:

-Coordinate ITD reporting for 2008; manage ITD interfaces to Joint Undertaking; organization and management of Steering Committees and Consortium Management Committee; administer JU financial contributions and maintain records and financial accounts; preparation of Annexes 1b & 2b for 2010 Annual Implementation Plan; definition in detail the description of the yearly activities for each Work Package in the Description Work; establish the 2010 budget request for each members (including the CfPs budget request for year); prepare the Annexes 1A & 2B for 2010 Grant Agreements; co-ordinate the technical work through the presence of the highest level WP leaders; participation to the GB.

GRA0 - Calls for Proposals Year 2009

No CfPs will be launched during the year 2009

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, then will 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 2009

Define aircraft level requirements of primary structures based also on expectations of customers in terms of weight, maintenance and repair procedures; evolution of certification criteria as function of new technologies to be adopted; verification and validation plan definition; tools and methods requirements definition; main criteria for the down selection of technologies; analysis of criteria to define structural element.
Final definition of the reference airframe architecture necessary for LWC technologies evaluation, starting from the generic conventional regional aircraft overall architecture. According to the baseline architecture, materials, processes, loads, sizing conditions, manufacturing technologies, weights of main components will be evaluated. Define general architecture, materials, process, loads, sizing conditions of advanced airframe considering results of application studies and technologies assessment.
About sensorised structures, design and manufacturing of sensorised metal and composite samples will be developed. Materials, manufacturing techniques, sensor application and protection techniques will be investigated. New material development will be based on process and material specification. For laser-beam-welded structures definition of manufacturing process and coupons manufacturing for each material selected will be done. Activity regarding methodology for ISHM (Intelligent Structural Health Monitoring) (diagnostic) and methodology to increase impact analysis will be developed.
In details the following WPs will run during 2009:

WP 1.1 LWC Requirements . .
Main objectives of 2009 are: define the airworthiness requirements for certification, based on actual and future regulations, and the Verification and Validation plan; define the criteria for the down selection of the technologies, in terms of structural performances, weight, costs, manufacturing and certification issues.

WP 1.2 LWC Architectures.
The Activities concern:
Final definition of the reference airframe architecture necessary for LWC technologies evaluation, starting from the generic conventional regional aircraft overall architecture: position of wing spars and ribs, fuselage main frames, frame pitch, panels lay-out, etc.;
Define updates of the reference architecture considering the results of the application studies of the selected technologies.

WP1.3 GRA Enabling Technologies for LWC

In details the following WPs will run during 2009:

WP1.3.1 Enabling Sensors Technology for LWC.
Development of sensor technologies like fibre optics (FOBG and FOBR), Acoustic Emission (AE) and Acoustic-Ultrasound (AU), wireless technology, piezo-sensors to be used in future regional A/C for mechanical and thermal strain measurement, corrosion evaluation, temperature, humidity and damage detection. Design and manufacturing of sensorised metal and composite samples.

WP1.3.2 LWC Enabling Technologies for Layer.
Main objectives of 2009 are: development of multifunctional layer configurations of C/F fabric pre-preg with metallic (e.g. titanium or steal) wires interwoven in terms of manufacturability and properties evaluation, for high performance composite applications; design and optimisation of the manufacturing process will contribute to maximize the desired properties of the coupons / subcomponents.

WP1.3.3 LWC Enabling Technologies for Multilayer.
Main objective of 2009 is to develop multifunctional multilayer materials (thermo-set C/F with thermoplastic layer, metallic mesh in composite material, enhanced damping layers) for high-performance composite in terms of feasibility and properties evaluation.

WP1.3.4 LWC Enabling Methodologies for Design.
The WP will be approached from an aircraft level perspective covering aircraft systems and structures (multifunctional). Solutions will be sought as a combination of health management functionality, intrinsic reliability, and systems design.
The following objectives will be developed:

- Prediction of impact force and location.
- Development of smart finite element technology able to replicate experimental damage detection
- Development smart finite element probabilistic methodology for real state safety assessment.

WP1.3.5 LWC Enabling Technologies for Nanomaterials.
Main objective is to produce an innovative composite with the application of nano-particles utilizing the following techniques:

- To apply nano-filled resin system to produce an innovative pre-preg (nano-filled thermosetting resin and Carbon Fiber)
- To integrate an embedded bucky-paper
- To add an additional layer of nano-particles to the laminate

The more efficient nano-filler dispersion and pre-preg realization will be the instrument for the next activities: validation of expected benefits through experimental tests on nano-reinforced resin; process and material specifications for the new pre-preg.

WP1.3.6 LWC Enabling Technologies for Maintenance.
This WP will address function-based-design modelling for Intelligent Structural Health Monitoring (ISHM), structural diagnostic and different issues on repair materials, processes, quality assurance. The WP will take into account the most severe airworthiness rules and innovative technologies proposed and validated in the JTI LWC with regard to the fulfilment of the repaired structures. Adhesive bonding, smart patch, riveted technologies are considered to fulfil low weight and low maintenance cost target.

WP1.3.8 LWC Enabling Technologies for Advanced Metallic Materials.
Starting of the activities regarding the design of a fuselage panel on the basis of new riveted high stiffness stringer on tough skin and the laser beam welding of Titanium/Aluminium Lithium made elements,

In the 2009 the evaluation of the advanced metallic structure will be performed making use as comparing solutions the existing all-riveted metallic structure and the novel structure design coming from the work packages dedicated to the design and manufacturing of advanced composite structures (single-layer, multi-layer, sensorised composite structures). The following activities will be developed:

- Manufacturing process feasibility and definition
- Coupons/subcomponents manufacturing for each material selected

GRA1 - Calls for Proposals Year 2009

- **GRA1 (Call 1)**

For reference, in addition to the work outlined in the remainder of this Annual Implementation Plan for 2009, the following Calls for Proposal will be launched during the year 2009 :

GRA1 WP1.1 : Development of a software to optimize the weight and manufacturing cost in the preliminary structural analyses phase of the project;
GRA1 WP1.3.1 : Special application of FOBG sensors to investigate corrosion problems, temperature and humidity conditions on surface and inside the materials. FOBG instrumentation system achievement for Flight Test application qualification. Development and adoption of a technology based on FO sensors for thermal and mechanical strain measurement, damage detection in a whole area: Optical section;
GRA1 WP1.3.1 : FOBG instrumentation system achievement for Flight Test application qualification. FOBG Optical assembly and interconnection technology. Development and adoption of a technology based on FO sensors for thermal and mechanical strain measurement, damage detection in a whole area: Electronic section;
GRA1 WP1.3.1 : Design and validation of FOBG for SHM application;
GRA1 WP1.3.1 : Definition and fabrication of specimen, sensor integration, experimental set-up definition;
GRA1 WP1.3.1 : Design of sandwich structures for sensor integration, optimisation and manufacturing of sandwich core;
GRA1 WP1.3.1 : System integration for broadband acousto-ultrasonics and electromechanical impedance monitoring technology;
GRA1 WP1.3.1 : Development of wireless sensor Network Nodes for Operation in an Airborne environment;
GRA1 WP1.3.3 : Development and supply of new pre-preg material with high CAI value and good compatibility with thermoplastic layer;
GRA1 WP1.3.3 : Validation of conceptual laminates development tailored for forward fuselage application;
GRA1 WP1.3.4 : Non Destructive Evaluation (NDE) of a composite JTI GRA stiffened panel, response functions / metamodel; (of an sized full scale JTI GRA panel);
GRA1 WP1.3.4 : Diagnostic/ Prognostic methodologies/ code (residual strength evaluation) of a composite sensorised multilayer stiffened panel;
GRA1 WP1.3.4 : Development of Numerical Tool for the Optimum Placement of the SHM Sensors;
GRA1 WP1.3.5 : Development of a thermosetting resin filled with CNTs. Mechanical, chemical-physical, rheological characterization of the new material for the optimization of the product in agreement with the process parameters asked from the pre-preg supplier;
GRA1 WP1.3.5 : Resin-nanofiller dispersion system scale-up and development of a new nanofilled pre-preg. Production of new pre-preg for coupons and panels;
GRA1 WP1.3.5 : Modification of resin;
GRA1 WP1.3.5 : Preparation and mechanical test of panels;
GRA1 WP1.3.5 : Organic-modification tailored to promote the correct interaction between the polymer and the filler;
GRA1 WP1.3.5 : Developing of new processes and technique to improve electrical properties of CFRP laminates maintaining or improving mechanical characteristics by means of adding nanoparticles into the epoxy resin matrix. Interfay sealant for structural assembly and protection paints shall be considered as well;
GRA1 WP1.3.5 : Advanced Lightning tests on composite material for aviation;
GRA1 WP1.3.6 : Function-based-design modelling for Intelligent Stress Health Monitoring (ISHM), structural

Diagnostic;
GRA1 WP1.3.6 : Smart maintenance with adapted patches;
GRA1 WP1.3.6 : Definition of requirements and test practicability from airline perspective
GRA1 WP1.3.8 : Numerical simulation of a lower side metal integral fuselage panel for weight reduction ;

- **GRA1 - (Call 2)**

GRA1 WP1.3.1 : Definition Fatigue test of sensor integrated CFRP aircraft panels with stiffeners;
GRA1 WP1.3.2 : Advanced Lightning tests on composite material for aviation;

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.

For the above reasons the "Low Noise Configuration" domain within the GRA ITD is pursuing a dual purpose:

- to assess technologies aimed at reducing airframe noise which during approach and landing phases (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 towards other paramount functions for a next generation, green regional aircraft:
  - highly-efficient aerodynamics, Natural Laminar Flow (NLF) wing design to reduce fuel consumption and pollution at cruise conditions;
  - wing loading control to enhance aerodynamic efficiency in all flight conditions and, hence, to reduce fuel consumption and pollution over the whole mission and allow steeper initial climb, 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.

Low-noise enabling technologies to reduce aerodynamic noise emissions by wing High-Lift Devices (HLD), Main Landing Gear (MLG) and Nose Landing Gear (NLG), among those already matured through past European research programmes (RAIN, SILENCER, etc.) as well as more advanced concepts, will be investigated looking for their potential application to future regional aircraft.

Load control / alleviation concepts, based on active control of conventional / unconventional wing control movables, innovative control laws and wing aero-elastic tailoring as well as skin-friction reduction (passive flow control) technologies on NLF wings will be also assessed during the technology maturation phase. These concepts will be combined to HLD low-noise solutions, leading to a conceptual wing design for a future Regional A/C integrating conventional and advanced wing functions.

The domain work programme will develop through several phases: from the definition of requirements & architectures (WP 2.1), through the assessment of enabling technologies (WP 2.2) and subsequent application studies (WP 2.3), up to the final demonstrations (WP's 2.4, 2.5 and 2.6) of selected solutions.

Wing low-noise and advanced load control/alleviation integrated technologies will be demonstrated in flight on a flying test bed. MLG and NLG low-noise technologies will be demonstrated through full-size wind tunnel tests.

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 towards applications of proved technologies to future products.

GRA2 - LNC Work Programme Year 2009

The activities planned over the concerned project period are inherent in the completion of the "Requirements & Architectures" definition (WP 2.1) and in the beginning of "Enabling Technologies" assessment (WP 2.2), as outlined below.

WP 2.1 Requirements & Architectures

- Completion of task relevant to the airframe noise reduction target definition, based on:
  - preliminary evaluation of community noise for a generic regional A/C, according to the current acoustic certification normative;
  - estimate of major airframe noise contributors (HLD and landing gears) and of relevant benefits expected by the concerned low-noise technologies.

- Completion of activities related to the NLF wing design, as baseline configuration for the subsequent development of low-noise and advanced aerodynamics wing technologies. The wing will be designed relatively to a preliminary configuration layout and preliminary requirements of a future green regional aircraft with advanced (open-rotor) aft-fuselage power plant architecture. In particular the following tasks are planned:
  - Computational Fluid Dynamics (CFD) based aerodynamic optimisation to achieve a wing shaping featuring natural laminar flow, , at key design point(s);
  - multi-disciplinary wing design coupling CFD and aero-elastic analysis to achieve the best structural efficiency still preserving the natural laminar flow extension;
  - assessment through semi-empirical methodologies of NLF robustness against wing surface irregularities due to manufacturing/ environmental issues.

- Definition of benchmark A/C loads simulation model for the subsequent loads control/alleviation technology development phase.

- Identification of potential load control/ alleviation strategy, through parametric modelling of aerodynamics, flight mechanics, structural load dynamics, simulating both conventional and unconventional wing control movables. In particular:
  - trade-off studies to map wing loading alleviation effectiveness and active aero efficiency through control movables combined with aero-elastic tailoring;
  - identification of potential load control/ alleviation actuation system architectures and relevant functional hazard and system safety assessment;
  - consequent identification of multi-disciplinary requirements/ constraints (weight, structures, systems, maintenance, safety, airworthiness, etc.) architectures and actuation of wing movables have to comply with.

- Completion of tasks dealing with the specification of MLG and NLG architectures. Such activities will consist in the identification of landing gears basic characteristics and of related structural/kinematics interfaces for a generic regional aircraft (low-wing configuration), based on preliminary design issues at A/C level.

- Identification of typology and subsequent definition of MLG and NLG reference architectures, based on the relevant specifications (see above), for the subsequent low-noise related technologies development phase.

- Completion of documents dealing with the specification of numerical tools for analysis and design (semi-empirical methodologies, CFD flow solvers, Multi-Disciplinary Optimisation (MDO), simulation tools, etc.) to address, in a multi-physics view, wing loads control/alleviation concepts.

- Completion of documents dealing with the specification of numerical tools for analysis and design (semi-empirical methodologies, CFD flow solvers, Computational Aero-Acoustics (CAA), MDO, simulation tools, etc.) to address in a multi-physics view HLD and LG low-noise solutions

- Completion of the Verification & Validation Plan documents, inherent to wing, MLG and NLG technological fields of the LNC domain).

WP 2.2 Enabling Technologies

- First part of the technology development phase concerning HLD low-noise solutions. Passive and active technologies to reduce flap side edges and upper slat trailing edge (TE) vortex flow induced noise emissions will be especially addressed, together with more advanced concepts related to gapless/morphing architectures, as described hereinafter.
  i. HLD passive low-noise treatments (embodied porous materials, brush-like devices, serrations, etc.);
  ii. multi-element wing camber optimisation and innovative kinematics so as to achieve HLD low-noise design (smaller deflections, reduced slots and tracks fairings) still preserving high-lift performance;
  iii. advanced low-noise concepts addressing morphing, hinge-less wing TE structures and smart actuation of gapless leading edge (LE) architectures (drooped nose, Krueger shaping);
  iv. active flow control through synthetic jets to enhance airfoil high-lift capability and, hence, indirectly achieve HLD low-noise configurations.

  For the above concepts/technologies, during the reference project period a pre-screening of most promising solution and part of activities related to MDO design, CFD/CAA analyses, preliminary multi-physics feasibility studies will be undertaken.

- Beginning of the technology maturation phase concerning active wing loads control/ alleviation and highly-efficient aerodynamics advanced concepts. In particular, preliminary studies concerning the topics described hereinafter will be accomplished.
  i. Wing control movables aero-mechanical concepts development including: assessment of new rapid wing tip devices; innovative seamless surfaces for lift distribution control; new rapid trailing edge 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 LE and TE to maximise wing efficiency and adaptive wing concepts). In support to such activity, during the concerned project period, the development of higher-order, parametric (aerodynamic, structural, aero-elastic) modelling of wing and relevant devices will start.

- Part of the technology maturation phase concerning passive flow control concepts, as described hereinafter.
  i. Definition of test matrix and specification, D&M of test model for 2D Wind-Tunnel tests at high-speed conditions of the baseline NLF wing profile. These experiments are aimed to assess the laminar flow robustness against manufacturing imperfections by properly simulating relevant surface irregularities and, hence, to establish maximum tolerable roughness height, steps & gaps size, contour waviness, compatible with a natural laminar flow.
  ii. Identification of most promising concepts and part of theoretical investigations, through CFD based numerical analyses, of technologies to reduce skin friction on NLF wings in the turbulent flow region (micro-riblets) and, possibly, delay the laminar-turbulent flow transition (innovative, micro-roughness surface treatments).
- Initial activities (State-of-the-Art review and first down-selection of most promising concepts) relevant to the development of MLG low-noise conceptual design, considering gear functionality constraints.

GRA2 - Calls for Proposals Year 2009

- **GRA2 - (Call 1)**

For reference, in addition to the work outlined in the remainder of this Annual Implementation Plan for 2009, the following Calls for Proposal will be launched during the year 2009:

GRA2 WP2.2.1 : Fluid Dynamic and Aero-acoustic 3D numerical analyses of wing High-Lift-Devices (HLD), to support the ranking of relevant best conceptual solutions in a multi-physics view (low-noise emissions, aerodynamic performance);
GRA2 WP2.2.1 : Feasibility analyses (materials, structural impact, installation, maintenance) of potential HLD passive acoustic treatments (brush-like devices, porous surfaces, etc) to support the ranking of best conceptual solutions;
GRA2 WP2.2.1 : Acoustic Semi-empirical laws for 2D design of conventional (three-element airfoil) HLD (High Lift Device) architectures and gapless (two-element airfoil) HLD architectures;
GRA2 WP2.2.1 : Design & Manufacturing of Synthetic Jets actual actuators and wind tunnel model variant;

- **GRA2 - (Call 2)**

GRA2 WP2.2.1 : 3D design of flap side edge active flow control;
GRA2 WP2.2.1 : LE coupon based technology test;

GRA3 – All Electrical Aircraft (AEA) domain

GRA3 - AEA overview

This GRA3 domain is mainly focused on studies, validation and verification activities aimed at demonstrating the feasibility of All Electrical Aircraft (AEA) systems configuration 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, Energy Management solutions shall be extensively investigated and demonstrated. Energy management is the control of aircraft loads – electrical in an "all electrical" frame – 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. As a consequence, all on-board systems and related technologies (e.g., electrical and electronic technologies for generation, distribution and control, air conditioning and pressurization, ice protection, actuation (flight controls, landing gears, …), engine and its accessories) shall be reviewed and reconsidered. 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 2009

During year 2009, the GRA3 will complete the definition of the aircraft level requirements and almost complete the definition of integration requirements for the On-Board Systems relevant to the All Electrical Aircraft (AEA) for the Future Regional Aircraft and for systems affected by Energy Management when actually tested in the demonstration either on ground and in flight. A preliminary V&V plan for energy management demonstration will be prepared.

The following activities relevant to Methods and Tools will be performed:
- for the selection and adaptation of tools and methods suitable for the Energy Management design,
- for the selection of a simulation platform suitable for the development of the dynamic simulation software
- for initial architecture definition of a shared simulation environment;

The AEA Application Studies activities will be launched.

In details the following WPs will run during 2009:

WP3.1.1 AEA high level requirements for system.
It will be completed the collection, analysis and review of the aircraft level requirements established for the configuration development and detail design of the on-board systems relevant to the All Electrical Aircraft (AEA) for the Future Regional Aircraft.
The requirements will be based on the reference A/C characteristics and Top Level A/C Requirements (TLAR) as input from the GRA New Configuration (NC) domain and will result from three in-parallel activities analysing the aspects and addressing the requirements affecting the electrical, mechanical and engine interface solutions, respectively.
It is expecetd also to collect requirements and objectives from operators of Regional A/C.
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WP3.1.2 AEA Integration requirements for system.
It will be almost completed the definition of integration requirements for the on board systems and sub-systems relevant to the All Electrical Aircraft (AEA) for the Future Regional Aircraft,. The requirements will comprise architecture, performance, installation, functional, qualification and certification and will result from two in-parallel activities assessing the installation/integration and qualification/certification requirements, respectively. For the purpose, the activity will based on the input coming from the WP 3.1.1, and will process

data received from EDS ITD, concerning candidate concepts and technologies, and from SGO ITD concerning reference architecture for Management of A/C Energy.

WP3.1.3 AEA demo requirements and architectures.
It will be preliminary performed the definition of the the requirements for the on board systems and sub-systems relevant to the All Electrical Aircraft (AEA) for the Future Regional Aircraft systems affected by Energy Management when actually tested in the demonstration either on ground and in flight.
The requirements will comprise architecture, performance, installation, functional, qualification and certification suitable to demonstration solutions that will result from two in-parallel activities assessing the requirements at a/c and systems/sub-system level, respectively.
A third activity will preliminary assess the overall verification and validation plan for Energy management demonstration into GRA
For the purpose, the activity will based on the input coming from the WP 3.1.1, and WP 3.1.2. Data from SGO, concerning assessment methods, V&V strategies and Technologies will be also processed.

WP3.2 AEA Technologies for System. .
The WP aims at the selection and adaptation of tools and methods suitable to the Energy Management design and simulation (e.g. the dynamic simulation of electrical loads during typical missions of an all-electrical regional aircraft).
In the 2009 it will be preliminary performed :

- the selection process of tools and methods suitable for the Energy Management design;
- the selection process of a simulation platform suitable for the development of the dynamic simulation software; to define a preliminary architecture of the shared simulation environment;
- the development of models of the subsystems for the simulation of power requests and energy management;
- the identification process of test cases to be used for the development and the validation of the models of the subsystems

In 2009 a CfP is planned to be issued for the development of flexible tool that enables the system designer or aircraft architect to analyze the impact of system architecture change and technologies selection at the aircraft level to support the a/c preliminary design phase.

WP3.3.1 Future Aircraft Configuration for AEA.
A Kick off Meeting will be arranged to launch the WP activities.
In 2009 the activities of analysis of functions and performance of systems either in steady state and dynamic conditions (mechanical, pneumatic, thermal, electrical) for the Future Regional Aircraft will be just started.

GRA3 - Calls for Proposals Year 2009

- **GRA3 - (Call 1)**

  For reference, in addition to the work outlined in the remainder of this Annual Implementation Plan for 2009, the following Call for Proposal will be launched during the year 2009:

GRA3 WP3.2: Development of a software to evaluate impacts coming from different avionics solution and to optimise on board system during the preliminary phase of the project;

GRA4 - Mission and Trajectory Management (MTM) domain

GRA4 - MTM overview

The activities regarding Mission and Trajectory Management (MTM) will be performed in GRA ITD in tight cooperation with Systems for Green Operations (SGO) ITD.
The over-all idea is that GRA ITD will define Regional aircraft high level requirements and MTM peculiar functionalities. These inputs will be 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 simulation device. Finally, the simulation device will run tests in order to assess the environmental benefits deriving from new green technologies.
In 2009 Alenia will participate to SGO activities starting regional trajectory definition and supporting optimisation tool development. During this activity SESAR Conops will be analysed in order to identify regional a/c peculiarities.

GRA4 - MTM Work Programme Year 2009

The activities planned for 2009 are:

- A/C high level requirements for MTM (WP 4.1.1)
- Requirements for MTM demonstration (WP 4.1.2)
- Avionics Architecture (WP 4.2.1)
- Basic prototyping tool preparation (WP 4.2.2)

WP4.1.1 A/C high level requirements for MTM.
During 2009 the following subjects will be studied:

- ü Methods and tools;
- ü High level regional A/C requirements;
- ü Operational scenario;
- ü Validation and Verification plan;
- ü MTM functional requirements.

WP4.1.2 Requirements for MTM demonstration.
The aim of this WP is to define the requirements for MTM demonstration, in terms of demonstration criteria and methodology, and demonstration scenarios. The output of these tasks will be used during test cases elaboration (GRA 4.4)In 2009 activities regarding demonstration criteria and methodology will be launched.

WP4.2.1 Avionics architectures.
The aim of this WP is to define an avionics architecture. In 2009 an activity of avionics architecture definition will be started.

WP4.2.2 basic prototyping tool.
The activities concerning definition of the GRA simulation device architecture and its interfaces will be continued.

GRA4 - Calls for Proposals Year 2009

- **GRA4 - (Call 1)**

For reference, in addition to the work outlined in the remainder of this Annual Implementation Plan for 2009, the following Call for Proposal will be launched during the year 2009 :
GRA4 WP4.2.1 : Study regarding regional aircraft avionics architecture supporting new MTM functionalities

GRA5 – New Configuration (NC) domain

GRA5 - NC overview

Regional aircraft high level requirements, including power-plant, will be first issued, from which engineering type requirements will be developed.
It is envisaged that a turboprop and a turbofan aircraft reference configuration will be set up, and that green overall configurations will be developed using turboprop, turbofan and open rotor advanced powerplants.
The technology development results obtained in the other GRA domains (1 to 4) will also be integrated in the green overall configuration to the purpose of evaluating cross effects and of calculating the benefits for the environment. NC effort's will be concentrate on the classification of all possible architectures matched with all compatible and innovative power-plants enabling the integration.

GRA5 - NC Work Programme Year 2009

In year 2009 the activity will start with first issue of aircraft requirements definition for Green Regional Aircrafts, and furthermore, a general description of two reference aircraft will be made. This description will include all relevant information about reference A/C in order to understand the current technology about important features as noise and engine emissions. Another task will be oriented to support the Technology evaluator: this item will consist of some methodology implementation in order to give proper tools to T.E. and to establish green features of the green and reference configurations.

Tools and methodologies task will be oriented to acquire tools to evaluate in improved way the aircraft sizing process and to evaluate specific items as engine emissions.

Following the general TLAR requirements definition, the task dedicated to the Powerplant requirements will start on the beginning of 2009 and it will define the engine high level requirements for green aircraft. In this period will start also the activity of sizing of the green power-plants and the first issue of engine data set will be issued.

In details the following WPs will run during 2009:

WP 5.1.1 High level requirements for aircraft.

This WP concerns the Top Level Requirements for Green regional Aircraft.

WP 5.1.2 High level requirements for power-plants.
This WP concerns the specifications for the engine power-plant employing the General Aircrafts Top level requirements released from the previous WP (5.1.1).

WP 5.2.1 Aircraft general architectures and performance.
This WP concerns the activities regarding the Reference aircrafts (T/F and T/P). Furthermore the start of studies for design of a preliminary configurations of Turboprop, Turbofan and Open Rotor Green Aircrafts is foreseen. Data of noise and emission for the reference aircrafts (Turboprop and Turbofan) for the Technology Evaluator will be prepared .
Tools and methodologies integration will be developed in order to perform the above mentioned activities.

WP 5.2.2 GRA Powerplant architectures.
This WP concerns the definition of architectures, performances, main characteristics and relevant systems of three engines (T/P, T/F and O/R) in order to size three Green aircrafts configurations.

WP 5.3 Powerplant airframe integration for NC.

This WP concerns the studies of the three Green aircrafts/engine Powerplant integration. These studies aim to reduce the emission, fuel burn and external noise of the all A/C configuration.

WP 5.4.1 NC technologies selection for the demonstrations.
This WP concerns the criteria to calibrate the trade off studies, in order to single out the most promising configuration .

GRA5 - Calls for Proposals Year 2009

- **GRA5 - (Call 1)**

  For reference, in addition to the work outlined in the remainder of this Annual Implementation Plan for 2009, the following Calls for Proposal will be launched during the year 2009 :

GRA5 WP5.2.1: Preliminary design methodologies, low airframe noise, emissions and fuel consumption
GRA5 WP5.2.1: Blade noise simulation;
GRA5 WP5.1.1: Future green regional aircraft requirements;
GRA5 WP5.2.1: Pod techniques ;