Green Regional Aircraft

Annual Implementation Plan 2010

Annex 1b

Table of content

Abbreviations and Definitions

A/C	Aircraft
AEA	All Electrical Aircraft (one of the technology domains of the GRA ITD)
CFD	Computational Fluid Dynamics
CAA	Computational Aero-Acoustics
CfPs	Call for Proposals
CSJU	Clean Sky Joint Undertaking
D&M	Design and Manufacturing
GA	Grant Agreement
GB	Governing Board
HLD	High-Lift Devices
ITD	Integrated Technology Demonstrator
JTI	Joint Technology Initiative
LE	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	(cruise) Mach Number
MDO	Multi-Disciplinary Optimisation
MLG	Main Landing Gear
MTM	Mission &Trajectory Management (one of the technology domains of the GRA ITD)
MP	Management Plan
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
SSE	Shared Simulation Environment
TE	Trailing Edge
TF	Turbo-Fan
TP	Turbo-Prop
WP	Work Package
WT	Wind Tunnel
WTT	Wind Tunnel Tests
2D	Two-Dimensional
3D	Three-Dimensional

Description of work for year 2010

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 2010

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 is setting 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 2010; 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 2011 Annual Implementation Plan; definition in detail the description of the yearly activities for each Work Package in the Description Work; establish the 2011 budget request for each members (including the CfPs budget request for year); 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 2010 and for 2011 Grant Agreements; co-ordinate the technical work through the presence of the highest level WP leaders; participation to the GB.

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 2010

Verification & Validation plan and criteria for down selection of technologies, in terms of structural performances, weight, costs, manufacturing and certification issue, will be completed. The requirements to select the structure elements will be defined. The reference architecture considering the results of application studies of the selected technologies will be completed. The assessment of the effect on the airframe structures architectures of peculiar item linked to advanced aircraft configuration will start.
About sensorised structures, design and manufacturing of sensorised metal and composite samples will be completed. Materials, manufacturing techniques, sensor application and protection techniques will be developed. New material development will be based on process and material specification; Test article manufacturing and testing activity in order to evaluate new material will start. Activity regarding methodology for ISHM (Intelligent Structural Health Monitoring) (diagnostic) and methodology to increase impact analysis will be developed. Preliminary design of fuselage/empennage/wing components of generic regional aircraft by selecting the most appropriate technologies will be done. Definition of the structure components of the flight/ground demonstrator will be done. In details the following WPs will run during 2010:

WP 1.1 LWC Requirements :
Main objectives of 2010 are: completion of definition of the Verification and Validation plan and the criteria for the down selection of the technologies; completion of definition of the criteria to be followed in the application studies in order to define the structural elements to be analyzed versus the applicable technologies; define the requirements to be considered in the different parts of the structure to finalize configuration, weight, manufacturing process, maintenance, etc. of the generic future regional aircraft; define the requirements to be considered in the selection of structure elements to be demonstrate and in the definition of their configuration, and the criteria to obtain the permit to fly .

WP 1.2 LWC Architectures :
The Activities concerns:

- Definition of general architecture, materials, processes, loads, sizing conditions, manufacturing technologies, weights of main components of advanced airframe considering the results of the application studies and the selected technologies.

- Evaluation of aircraft data necessary to direct the technology development and the application studies, and to assess their effects on the controlling parameters at aircraft level.
- Assessment on the airframe structures of peculiar items linked to advanced aircraft configurations.

WP1.3 GRA Enabling Technologies for LWC

In details the following WPs will run during 2010:

WP1.3.1 Enabling Sensors Technology for LWC :
Main activities of 2010 are: test articles manufactured and test activities for all developed technologies and test report .

WP1.3.2 LWC Enabling Technologies for Layer :
Main objectives of 2010 are: completion of design and optimisation of the manufacturing process in order to maximize the desired properties of the coupons / subcomponents, test article configuration and test plan definition, test article manufacturing, basic testing activity (chemical-physical, mechanical and specific for multi-functionality) and results analysis.

WP1.3.3 LWC Enabling Technologies for Multilayer :
Main objectives of 2010 are: completion of multifunctional multilayer materials development for high-performance composite, development of process feasibility assessment and test article configuration definition, coupons/subcomponents manufacturing, basic testing activity (chemical-physical, mechanical and specific for multi-functionality) and results analysis.

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.

Main objectives of 2010 are:

- Methodologies to predict damage in the impacted composite structure. Methodologies to transfer flight loads in to internal stress/interface mesh load/stress;
- Methodologies to detect size and damage location, mesh methodologies for multi GDOF model.

WP1.3.5 LWC Enabling Technologies for Nanomaterials :
Main objective of 2010 are:

- Completion of activities to apply nano-filled resin system to produce an innovative pre-preg (nano-filled thermosetting resin and Carbon Fiber);
- Completion of activities to integrate an embedded bucky-paper;
- Completion of activities to add an additional layer of nano-particles to the laminate;
- nano-reinforced composites technology development, nano-reinforced subcomponents manufacturing for each material/technology selected and mechanical and functional tests on the panels.

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.
Main objective of 2010 are:

- Selection and characterization of the advanced repair technologies
- Guideline to repair the LWC principal structure

WP1.3.7 LWC Enabling hybrid Technologies:
Main objective of 2010 are identification of specific multifunctional properties to test. Process manufacturing validation will start.

WP1.3.8 LWC Enabling Technologies for Advanced Metallic Materials :
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).
Main objective of 2010 are:

- completion of manufacturing process feasibility and definition
- coupons/subcomponents manufacturing for each material/technology selected and testing activity for the adoption in the future regional a/c.

WP1.4.1 LWC Enabling Ranking of applicable technologies :
Main objectives of 2010 are analysis of technologies best fitting to empennages, wing and fuselage/cockpit. To define an engineering analysis, performed using mainly the advanced methods developed in WP 1.3, manufacturing engineering evaluations, and assessment of the technologies better fitting the requirements established in WP 1.1. Definition of the configurations and of the manufacturing processes of the main structure elements (empennage, wing, fuselage/cockpit) of a generic future regional aircraft using the most promising technologies after the first assessments. Define a weight, manufacturing and maintainability engineering evaluation for the proof test article. Define a reference test article (reference panel) sized considering the traditional materials and technologies. Define a weight, manufacturing and maintainability engineering evaluation for the proof test article and the reference test article. Define a trade off between the proof test article and the reference test article in order to select the structural solution to be tested in WP 1.3.7, complying with the requirements established in WP 1.1.

WP1.4.2 LWC Technical solution for regional A/C :
Main activity to be performed in the present WP is the definition of the technical solutions to be used on such items as components of the future generic regional aircraft. The solutions will be identified among the technologies selected in the WP 1.3.
Main objective of 2010 is to start preliminarily the definition of the technical solutions.

WP1.5.1 LWC Definition of Flight demonstration : WP
Main activities to be performed in the present WP are the definition of the technical solutions of the structure components of the flight demonstrator and the definition of the test plan, test lay-out, test article/platform.
Main objective of 2010 is to start preliminarily the selection of the aircraft on which to perform the flight test.

WP1.5.2 LWC Definition of Ground demonstration :
Main activities to be performed in the present WP are the definition of the technical solutions of the structure components of the ground demonstration and the definition of the test plan, test lay-out, test article/platform.
Main objective of 2010 is to start preliminarily the definition of the experimental data to be acquired.

GRA1 - Calls for Proposals Year 2010

In addition to the work outlined in the remainder of this Annual Implementation Plan for 2010, Calls for Proposal will be launched during the year 2010.

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" project 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 toward other paramount functions for a next generation, green regional aircraft:
  - highly-efficient aerodynamics, Natural Laminar Flow (NLF) wing concept to reduce fuel consumption and pollution at cruise condition;
  - 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), 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 will be also assessed along the technology maturation phase.

The LNC project 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.
MLG and NLG low-noise architectures/technologies will be demonstrated through full-size aerodynamic and aero-acoustic low-speed 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 toward applications of proved technologies to future products.

GRA2 - LNC Work Programme Year 2010

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

WP 2.1 Requirements & Architectures: The multi-disciplinary design (aerodynamic optimisation and aero-elastic modelling) of a baseline NLF wing for a future A/C together with the definition of relevant HLD architecture (double-slotted TE flap) have been completed in the course of 2009. Therefore, the activities of this work package over year 2010 will be dealing with wing designs and preliminary technology studies toward other configurations. In particular:

- Wing design (cruise and low-speed configuration) based on general architecture and top-level requirements of a future TP A/C with conventional (wing-mounted propeller engines) power-plant;

- Wing design (cruise and low-speed configuration) based on general architecture and top-level requirements of a future TF A/C with under-wing engine nacelle installation. This activity will be assigned through Call-for-Proposals .

The above activities for both the wing configurations considered will develop through the following tasks:

  - CFD based wing aerodynamic optimisation to achieve the best aerodynamic efficiency at key design point(s), by considering both cruise and climbing performances;
  - multi-disciplinary wing design coupling CFD and aero-elastic analysis to achieve the best structural efficiency, still preserving the aerodynamic behaviour;
  - HLD architecture design (aerodynamic shaping and settings) to optimise lift-to-drag ratio during take-off/first climbing flight phases and to meet high-lift requirements at approach/landing flight conditions.

- Identification of potential load control/alleviation strategy, through parametric modelling of aerodynamics, flight mechanics, structural load dynamics, simulating both conventional and innovative 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 definition of MLG and NLG - fuselage mounted solution - for a TP high-wing A/C configuration, based on the relevant requirements specification, as baseline architectures for the subsequent low-noise related technologies development phase.

WP 2.2 Enabling Technologies: Over year 2010 the technology development for the NLF/OR, TP and TF wing concepts defined in WP 2.1, will take place, tailored to respective wing configurations and relevant baseline HLD architectures. At the same time, LG low-noise technologies for a TP (high-wing) A/C configuration will be addressed. The activities inherent in the concerned technology fields are described hereinafter.

- HLD low-noise studies, by considering passive and active technologies to reduce vortex flow induced noise emissions together with more advanced concepts, as highlighted below:

  i. HLD passive low-noise treatments (acoustic liners, brush-like devices, serrations, etc.) to reduce noise sources due to e.g. flap side edge vortices, slat cove vortical flows, vortex shedding;

  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 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.

After a pre-screening of potential concepts/technologies as above described, MDO design, CFD/CAA based 3D numerical analyses and multi-physics feasibility studies will be undertaken toward the relevant down-selection of most promising solutions for subsequent WTT validation.

- Technology maturation phase concerning active wing loads control/alleviation and highly-efficient aerodynamics advanced concepts. In particular, activities dealing with the following topics will be carried out.

  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, higher-order, parametric (aerodynamic, structural, aero-elastic) modelling of wing and relevant devices will be generated.

- Technology maturation phase concerning passive flow control concepts, as described hereinafter.

  i. Following test requirements and test article specifications (performed in 2009), completion of D&M of test model and carrying out of 2D WT tests at high-speed conditions on a generic NLF wing profile. These experiments are aimed to assess the laminar flow robustness against manufacturing imperfections and environmental issues (e.g. insect smashing), 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. Following most promising concepts down-selection (performed in 2009), 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).

- Following relevant requirements specification (released in 2009), the initial part of technology studies toward the development of MLG and NLG low-noise conceptual design for a future TP high-wing A/C configuration will take place. In particular, after a State-of-the-Art review and consequent first down-selection of most promising concepts, the aero-acoustic design of the LG and of the LG bay will be carried out through semi-empirical methodologies validated by CFD/CAA numerical analyses. In this respect, both gear and gear integration (fuselage mounted features) functionality constraints will be considered.

GRA2 - Calls for Proposals Year 2010

In addition to the work outlined in the remainder of this Annual Implementation Plan for 2010, Calls for Proposal will be launched during the year 2010.

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 Green 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. All on-board systems and related 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 2010

During 2010 the GRA3 will 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 V&V plan for energy management demonstration will be issued.

The following activities relevant to Methods and Tools suitable to the Energy Management design and simulation will be performed:

- Definition of requirements for the design of a Shared Simulation Environment (SSE) to be used for the assessment and the optimisation of the Energy Management logics.
- Choice of the software platform for the SSE development.
- Adaptation of existing simulation models

Analysis and studies will performed to define the future Green Regional Aircraft Configuration including start of the activities to study feasibility of power controller for different types of electrical motors and to study an innovative aircraft motion system (WP 3.3.1). The activities for AEA Demonstrator configuration definition will be launched (WP 3.3.2).
In details the following WPs will run during 2010:

WP3.1.2 AEA Integration requirements for system:
It will be completed the definition of integration requirements for the on board systems and sub-systems relevant to the All Electrical Aircraft (AEA) for the Future Green 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 completed the definition of the the requirements for the on board systems and sub-systems relevant to the All Electrical Aircraft (AEA) for the Future Green 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 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.

WP 3.2 AEA technologies for systems (methods & tools):
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 2010 will continue the ones carried out during the year 2009, mainly addressing the following points:

- Definition of the SSE requirements

  - *Expected activities in the year 2010*: The requirements for the SSE development will be definitely defined in terms of software environment, model complexity, model input/output, methods for model integration and validation

- Selection of the software platform for the SSE development

  Expected activities in the year 2010: the software platform for the SSE development will be chosen, by performing a critical comparison among the three candidate platforms.

- Selection and adaptation of tools for A/C systems simulation

  - *Expected activities in the year 2010:* The selected existing models for A/C systems simulation will be adapted according to the SSE requirements and the features of the simulation platform chosen. The development of the missing models will start within the WP 3.2 group for the first level of models complexity ("Architectural" level). In 2010 a CfP is planned to be issued for the development of the missing models of aircraft systems, according to the SSE requirements, for the most accurate level of model complexity ("Behavioural" level).

- Development of Thermal Architecture Model of regional aircraft

  during the definition phase of Shared Simulation Environment preliminary architecture, the need for a dedicated aircraft thermal model has been highlighted;
  Expected activities in the year 2010:
  - Selection and adaptation of methods (low fidelity models for preliminary design phase, high fidelity models for detailed design phase) for the definition of the regional aircraft thermal architecture at different stages of design workflow.
  - Implementation of the regional aircraft preliminary thermal architecture model for the steady state and dynamic analysis of states and performances of Thermal Management relevant systems and subsystems.

WP3.3.1 Future Aircraft Configuration for AEA :
During 2010 analysis of function and performance, both in steady state and dynamic conditions (mechanical, pneumatc, electrical and thermal) of systems for an All Electrical future regional A/C will initiated (WP 3.3.1).
For the purpose, the activity will 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 will be processed.
It will be launched the activities to study feasibility of power controller for different types of electrical motors within an Energy Management architecture, with preparation and issuing of dedicated CfP.

WP3.3.2 Demonstrator Configuration for AEA:
A Kick off Meeting will be arranged to launch the WP activities.
In 2010 the activity of analysis of functions and performance, either in steady state and dynamic conditions (mechanical, pneumatic, thermal, electrical) of systems interested to the ground and in-flight demonstration of Energy Management will be started.
For the purpose, the activity will based on the input coming from the WP 3.1.3 - AEA demo requirements and architectures

GRA3 - Calls for Proposals Year 2010

In addition to the work outlined in the remainder of this Annual Implementation Plan for 2010, Calls for Proposal will be launched during the year 2010.

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 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 2010

The activities planned for 2010 are:

- A/C high level requirements for MTM (WP 4.1.1) – started in 2008
- Requirements for MTM demonstration (WP 4.1.2) – started in 2009
- Avionics Architecture (WP 4.2.1) – started in 2009
- Basic prototyping tool preparation (WP 4.2.2) – started in 2008

WP4.1.1 A/C high level requirements for MTM :
During 2010 the following subjects will be studied:

- MTM functional requirements – started in 2009
- High level regional aircraft implementation constraints – started in 2009
- Safety requirements – started in 2009
- Operational scenario – started in 2009

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 2010 the following activities will be performed:

- Demonstration criteria, methodology and requirements - started in 2009
- Scenarios analysis

WP4.2.1 Avionics architectures :
The aim of this WP is to define an avionics architecture. In 2010 the activity of avionics architecture definition, started in late 2009, will be concluded.

WP4.2.2 Basic prototyping tool :
The activities concerning definition of the GRA simulation device architecture and its interfaces will be concluded.
Moreover, the following activities will be performed:

- Definition of the detailed GRA simulation architecture/ICD documents/functional tests – started in 2008
- Flight Simulator components technical specification, acquisition and/or implementation
- Development of the real-time environment and of the basic A/C models

- Development of the essential A/C systems basic models
- Basic ATM scenario modelling
- Peculiar GRA HMI modelling related to FMS
- Peculiar GRA HMI modelling (excluding FMS)
- Functional tests (related to FMS)

GRA4 - Calls for Proposals Year 2010

In addition to the work outlined in the remainder of this Annual Implementation Plan for 2010, Calls for Proposal will be launched during the year 2010.

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 power plants.
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.
Activities on powerplant integration issues will be performed, largely addressed to open rotor noise and vibrations. 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 to the peculiar technologies developed in each GRA technology domain.

GRA5 - NC Work Programme Year 2010

In year 2010 NC domain activities will be focused on Loop 2 of Green Aircraft Preliminary Sizing activities The main activities are:

- Update the green aircraft/powerplant requirements;
- Perform new aircraft/powerplant sizing activities;
- Support the Technology evaluator, by means of tools development, in order to establish features of the green configurations;
- Optimize the Powerplant/Airframe integration for all Green A/C configurations studied;
- Perform trade-off studies in order to compare different Green A/C configurations available from architecture/integration studies;

In details the following WPs will run during 2010:

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 goals are:
  - Provide High Level Aircraft Requirement (Loop 2) for general architecture and performance, considering also design and certification aspects, about a few Regional A/C studies.
  - Update the strategy and the plan for the Validation & Verification (Loop 2) of the benefits at A/C level resulting from the integration of the new technologies (coming from other domains) and requirement for plan implementation.
- **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 WP (5.1.1). The main objective is to update/redefine green high level powerplant requirements (thrust requirement on specifications point, power extraction and acoustic requirements, mass and geometry limiters).

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 configuration 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.
  Another task is devoted to support the Technology Evaluator that is to implement of some methodology in order to give proper tools to T.E. and to establish green features of the green configurations. A/C Configuration Low Speed preliminary verification Wind Tunnel Test will be performed in order to test and validate theoretical studies and investigations performed on advanced Regional A/C configurations handling qualities and performances.

  Preliminary design of Regional A/C Fuselage and after body (Fuselage - Empennages with integrated power-plant) and innovative concept optimized for minimize weight, maximize aerodynamic efficiency and best engine noise shielding are the objects of another task.

- **WP 5.2.2 GRA Powerplant architectures:** This WP concerns the definition of architectures, performances, main characteristics and relevant systems of three different green engines (T/P, T/F and O/R) in order to size the three Green aircrafts configuration. Year 2010 activities will be focused on Loop 2. For each propulsion system, preliminary design studies will be performed, followed by parametric studies in order to select the best compromise between performances, noise, integration constraints. These studies will integrate new technologies benefits and new energy systems impacts (more electrical A/C, high mechanical power extraction, thermal management).

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. 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. Besides, the following activities will be developed:

- WT Tests acoustic results analysis, comparisons and correlation of CAA model of with propeller-engine noise and forward/rear mask due to A/C components (tail shape) and pylon shape;
- definition of WT Test (WP5.3.5) requirements for acoustic and aerodynamic CROR propulsion installation;
- WT Tests aerodynamic results analysis (steady and unsteady pressures), comparisons and correlation of CFD model taking into account movable surfaces interactions.

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. Important values will be given to green features (emission and noise). Main activities of 2010 year are:

  - Trade-off studies for the final selection for the demonstration, highlighting pros and cons in terms of green features;
  - Selecting the best and technically feasible Green A/C configurations studied and sized in WP 5.2.1, 5.2.2 and 5.3.1

GRA5 - Calls for Proposals Year 2010

In addition to the work outlined in the remainder of this Annual Implementation Plan for 2010, Calls for Proposal will be launched during the year 2010.