Annual Implementation Plan 2013-2016

Annex 1b
**Table of content**

**DESCRIPTION OF WORK FOR YEARS 2013-2016** ........................................................................................................ 4

**GENERAL OVERVIEW** ......................................................................................................................................................... 4

**GRA0 – ITD MANAGEMENT** .................................................................................................................................................. 5
  GRA0 - Management overview ................................................................................................................................................... 5
  GRA0 - Work Programme Years 2013-2016 ............................................................................................................................... 5
  GRA0 - Calls for Proposals Years 2013-2016 ............................................................................................................................. 5

**GRA1 – LOW WEIGHT CONFIGURATION (LWC) DOMAIN** .................................................................................................. 6
  GRA1 - LWC overview ............................................................................................................................................................... 6
  GRA1 - LWC Work Programme Year 2013-2016 .......................................................................................................................... 6
  GRA1 - Calls for Proposals Years 2013-2016 ............................................................................................................................. 7

**GRA2 – LOW NOISE CONFIGURATION (LNC) DOMAIN** .................................................................................................... 8
  GRA2 - LNC overview ............................................................................................................................................................... 8
  GRA2 - LNC Work Programme Years 2013-2016 .......................................................................................................................... 9
  GRA1 - Calls for Proposals Years 2013-2016 ............................................................................................................................. 11

**GRA3 – ALL ELECTRICAL AIRCRAFT (AEA) DOMAIN** ..................................................................................................... 12
  GRA3 - AEA overview ............................................................................................................................................................... 12
  GRA3 - AEA Work Programme Years 2013-2016 .......................................................................................................................... 12
  GRA3 - Calls for Proposals Years 2013-2016 ............................................................................................................................. 14

**GRA4 - MISSION AND TRAJECTORY MANAGEMENT (MTM) DOMAIN** ................................................................. 15
  GRA4 - MTM overview ............................................................................................................................................................... 15
  GRA4 - MTM Work Programme Years 2013-2016 .......................................................................................................................... 15
  GRA4 - Calls for Proposals Years 2013-2016 ............................................................................................................................. 16

**GRA5 – NEW CONFIGURATION (NC) DOMAIN** ............................................................................................................... 17
  GRA5 - NC overview ............................................................................................................................................................... 17
  GRA5 - NC Work Programme Years 2013-2016 .......................................................................................................................... 17
  GRA5 - Calls for Proposals Years 2013-2016 ............................................................................................................................. 19
Green Regional Aircraft

**Abbreviations and Definitions**

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

Description of work for years 2013-2016

GENERAL OVERVIEW

GRA will continue the work packages defined in the baseline program, with internal review of the technologies to be further enhanced.

Main GRA ITD activities, in the period 2013 – 2016, will be largely involved in design, manufacturing and final testing of the following demonstration:

- **Ground Full Scale Demo** - the activities will be focalized on the Design (Critical Design Review - 2013), the Manufacturing of the Test Articles, of Tooling and Test Rig for the Execution of the Static and Fatigue Testing Activities.
- **ATR In Flight Demonstration** – Structural and Systems modifications will be applied on the ATR 72 Test A/C according to:
  - the scheduled CDR (Critical Design Review) in the 2013,
  - the completion of the A/C Ground Tests, the Flight Readiness Review (FRR) and the execution of the Flight.
- **Wind Tunnel Test** - Aeroacoustic & Aerodynamic Test of the A/C model and Main and Nose Landing Gear will be performed.
- **Flight Simulator Demo** – Demonstration of the Green FMS (Flight Management System) using a realistic Regional Flight Simulator will be executed.

Significant activities for each domains are:

- **GRA1 – Low Weight Configuration (LWC)** domain activities will be totally involved in the Design, Manufacturing and Testing of the Fuselage Section, Wing Box Section and Cockpit Section (almost cylindrical rear area) of the Full Scale Ground Demo. Further activities will be focalized on the Design and Manufacturing of the advanced composite Upper Crown Panel for the In-Flight Demonstration.
- **GRA2 – Low Noise Configuration (LNC)** domain activities will be involved on the completion of the Technologies Studies, in particular on the 2nd Down Selection of the "Main / Nose Landing Gear (MLG/NLG)” technology. All these technologies will be tested through the execution of the Aeroacoustic & Aerodynamic WTT of the 90 pax concept, the performance of the Aeroacoustic WTT of the Full Scale Landing Gear and the execution of the WT, Structural and Actuation Test of the Load Control / Alleviation (LC/A) system.
- **GRA3 – All Electrical Aircraft (AEA)** domain activities will concern the completion of the “E-ECS”, the “Advanced EPAGDS and Electric Energy Management (E-EM)”, the “Hybrid -WIPS” and the “FCS/LG EMA” Technologies Studies. In order to perform the In-Flight Demonstration, these technologies will be applied on the ATR Test A/C if the positive response will result from the Feasibility evaluation. AEA will also contribute to Copper Bird activities for the Laboratory Electrical Testing of the Regional A/C configuration including EPGDS and EMA.
- **GRA4 – Mission and Trajectory Management (MTM)** domain activities will be focalized on the development of the Green Flight Management System (FMS) and of the realistic Regional Flight Simulator in order to perform the Flight Simulation Demonstration in the 2015.
- **GRA5 – New Configuration (NC)** domain activities will be involved on the WTT campaign in order to investigate an Aeroacoustic Integration of Open Rotor Engine and an Aerodynamic WTT of the 130 pax Regional A/C model. In 2015 a Final Aeroacoustic & Aerodynamic Demo will be performed on the best configuration from the environmental point-of-view. In the same time the sizing of two Green Concepts typology, 90 pax, with TurboProp Engine, and 130 pax, with the Advanced-TurboFan, Geared TurboFan and Open Rotor Engines will be completed. Valuation and assessment of environmental targets and A/C model improvement with the delivery of the A/C Simulation Model (GRASM) to the Technology Evaluator for the assessment, will follow in this period.

GRA will also integrate the activities conducted by the partners selected by means of the CFPs.
Green Regional Aircraft

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 Years 2013-2016

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 years 2013-2016; 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; 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 Years 2013-2016

No CfP are currently planned for years 2013-2016.
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 2013-2016

During Years 2013-2016 in-flight and on ground demonstrations will be executed. In particular, a detailed design and manufacturing of the tools and demonstrator to be tested in flight will be carried out. The component to be installed on Test A/C will be manufactured with technologies selected during the Project. The in-flight demonstrator will be installed on Test A/C. Pre-flight tests and flight tests will be executed. A detailed design and manufacturing of the tools and demonstrators to be tested on ground will be also carried out. Ground demonstrators will be manufactured with technologies selected during the Project. Ground demonstrators will be assembled and prepared for full-scale tests. Demonstrators will be tested on ground.

The results analyses of full scale (in-flight and on ground) tests will be performed and reported in final reports.

In details the following WPs will run 2013-2016:

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

  The present WP is aimed to the execution of in-flight and on ground tests. Main activities to be performed are:

- **WP1.6.1 – WP1.6.2: Preparation of Demonstrations for LWC**

  - detailed design and manufacturing of the tools for manufacturing and assembling of demonstrator to be tested in-flight;
  - detailed design and manufacturing of the full-scale demonstrator to be installed on Test A/C ATR 72-600 MSN098 and tested in flight. The demonstrator will consist of a stiffened fuselage panel manufactured in a new composite high resistance to impact and including damping performance.
Radial and longitudinal splices and the respective interface structural components will be also designed and manufactured;

- removal of the identified panel on fwd fuselage to allow the adapting the new panel to be tested;
- Installation of the manufactured panel on ATR 72-600 MSN098;
- detailed design and manufacturing of the tools for manufacturing and assembling of demonstrators to be tested on ground;
- detailed design and manufacturing of full-scale demonstrators to be tested on ground. Three full-scale ground demonstrators will be manufactured with technologies selected during the Program: Cockpit Section (almost cylindrical rear area), Barrel Fuselage, Wing Box;
- assembling of each demonstrator including floors, windows frames, pressure bulkheads and dummy structures for barrel fuselage and cockpit.

❖ **WP1.6.3 – WP1.6.4: LWC Demonstrations**

- authorization to flight;
- installation of sensors for structural health monitoring and acoustic measurements;
- execution of pre-flight tests and flight tests;
- sensors installation and ground tests set-up;
- execution of ground static and fatigue tests for each of the three full-scale demonstrators.

❖ **WP1.7 LWC Analysis & final reporting**

The present WP is aimed to the:

- assessment of LWC domain results against requirements, including demonstrations results;
- assessment of TRL status after technologies maturation.

In the present WP, the analysis of the overall design or manufacturing benefit proved by demonstrations will be carried out.

All the considerations will be captured along final reports.

**GRA1 - Calls for Proposals Years 2013-2016**

For reference, in addition to the work outlined in the remainder of this Annual Implementation Plan for 2013-2016, the following Calls for Proposal will be launched during the Year 2013:

✔ **GRA1 – Call 2013 (batch# 2)**

GRA1 WP1.6: “Development of a primary aerospace structural component through optimization and virtual testing”
(Ref.: JTI-CS-2013-2-GRA-01-52)
Green Regional Aircraft

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 (droop 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 moveable and wing aero-elastic tailoring;
- Drag reduction through passive flow control devices to delay boundary layer transition (e.g. artificial micro-roughness) and to reduce turbulent skin friction (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, Advanced Turbo-Prop and Advanced Turbo-Fan aircraft with wing-mounted engines.

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 &
arhitectures (WP 2.1); ii) assessment of enabling technologies (WP 2.2); iii) application studies (WP 2.3);
iv) demonstrations (WP’s 2.4, 2.5 and 2.6) of selected concepts/technical solutions; v) project results
analysis and final reporting (WP 2.7).

The down-selection process of the addressed technologies will proceed in a multi-disciplinary 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 through large-scale aerodynamic, aero-
elastic, aero-servo-elastic and aero-acoustic wind-tunnel tests on A/C configurations models and through
ground demo (LC&A architecture control system).

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

**GRA2 - LNC Work Programme Years 2013-2016**

The activities planned over the reference period (until the end of the project) are inherent in “Enabling
Technologies” (WP 2.2), “Application Studies” (WP 2.3), “Definition, Preparation and Execution of
Demonstrations” (WPs 2.4, 2.5 & 2.6), and in “Project Results Analysis & Final Reporting” (WP 2.7) as
outlined below.

**WP 2.2 - Enabling Technologies**

The technological development of Main and Nose Landing Gear low-noise concepts toward application to
future green regional Turbo-Prop high-wing A/C configuration will be performed (2013), supported by aero-
acoustic wind-tunnel tests (2014) on large-scale (say 1:2) and full-scale mock-ups of MLG and NLG,
respectively. This activity will rely on a project under CIP (Ref.: JTI-CS-2011-3-GRA-02-017). The first part
(low-noise technology studies) will be performed in collaboration with Members of the GRA – LNC project
Consortium in order to: i) verify the compliancy of proposed concepts with the gear functionality and
integration requirements/constraints; ii) assess and down-select those concepts/technical solutions to be
brought to the aforementioned WT tests experimental validation phase. Both conventional and innovative
concepts/technologies are envisaged to be addressed and tested, concerning gear, bay cavity and bay
doors (e.g. strut and wheel pack fairings, spoilers, acoustic treatments, vortex disintegrators).

**WP 2.3 – Application Studies**

HLD architectures / technologies developed and down-selected in the frame of WP 2.2.1 will be applied to
the a 130-seat green regional A/C configuration, integrating a NLF wing design with innovative rear-fuselage
Geared Turbo-Fan (GTF) power plant, planned to be brought to the WT tests demonstration phase within
the GRA ITD work programme. Further aerodynamic analyses will be performed, if needed, to predict high-lift
performance. The conceptual design of HLD kinematic system will be optimised and defined in more detail.
Similar activities will be carried out to define the conceptual design of HLD tailored to a green Turbo-Prop
A/C 90-seat configuration.

LC&A concepts and relevant technical solutions (wing movables sizing/settings, actuation logic, control
system architecture), developed and down-selected in the frame of WP 2.2.5, will be sized and optimised to
the GTF A/C configuration. In particular, steady and unsteady aero-elasticity analyses will be performed to
assess aero-mechanical performances and LC&A devices effectiveness, in support to the subsequent WT
tests demonstration phase.
**WPs 2.4, 2.5, 2.6 - Demonstrations**

Several activities, dealing with tests requirements definition and test articles technical specification, will be performed (2013, 2014) with respect to the different experimental demonstrations, also in support of those testing activities planned to be performed through projects under CfP. Demonstrations to be performed are listed below.

- **Demonstrations tailored to 130-seat green regional A/C**
  a) **Wing aerodynamic and steady aero-elastic performances validation** (2013, 2014)

  High-speed WT tests will be carried out to investigate transonic NLF wing aerodynamic design and performances of LC&A devices in reducing induced drag and bending moment. An innovative flexible wing model, representative of the full-size wing deformation under aerodynamic loads, will be designed and built, and tested in a transonic WT facility at high Reynolds numbers close to in-flight conditions. These activities are planned to be performed within a project under CfP (Ref.: JTI-CS-2012-1-GRA-02-019).

  b) **LC&A control laws validation** (2014, 2015)

  Low-speed aero-servo-elastic WT tests will be carried out to investigate gust load alleviation strategy in a relevant environment. An innovative large-scale wing model will be designed and built, equipped with load alleviation devices integrated with active system models (sensors and actuators) with control laws in the loop. Tests will be performed in a large experimental facility with dynamic gust generator devices. These activities are planned to be performed within a project under CfP (see Topic #3).

  c) **LC&A system functionality validation** (2014, 2015)

  Full-size ground testing will be carried out to investigate the loads control system architecture (control laws, loads estimator, sensors and actuators). An actuation rig will be defined to perform such testing in order to validate the complete control system chain: i) real-time loads estimation model; ii) active load control algorithm under given simulated load conditions (gust, manoeuvre, turbulence); iii) dynamic response and effectiveness of LC&A devices fast actuators.

- **Demonstrations tailored to 90-seat green regional A/C**
  a) **S&C performances and airframe low-noise solutions validation** (2014, 2015)

  Low-speed aerodynamic and aero-acoustic WT tests through innovative experimental technique will be carried out to assess, at take-off/first climbing and approach conditions, the aircraft aerodynamic data set and HLD low-noise technologies. A large-scale A/C complete powered model will be designed and built, and tested in aerodynamic and acoustic experimental facilities. The A/C model D&M and aerodynamic test campaign are planned to be performed within a project under CfP (see Topic #1).

  b) **Main Landing Gear low-noise configuration validation**

  Aero-acoustic WT tests will be carried out on a full-size mock-up of the complete MLG architecture (gear strut, undercarriage, bay, doors, belly fairing, etc.) to investigate the relevant low-noise concepts/technical solutions down-selected from the previous test campaign on a scaled MLG model (see WP 2.2). The concerned activities (model D&M and testing) are planned to be performed within a project under CfP (see Topic #2).

**WP 2.7 – Results Analysis & Final Reporting**

The final stage of the activity plan will be dealing with an overall evaluation of project results, as well as with guidelines/recommendations for applications of green technologies to future products. Not only the concepts/technical solutions put to the final demonstrations activities, but all the technologies addressed within the project toward the achievements of ACARE goals in terms of future air transport environmental impact (noise and pollution) reduction will be reviewed and assessed.
Green Regional Aircraft

GRA1 - Calls for Proposals Years 2013-2016

For reference, in addition to the work outlined in the remainder of this Annual Implementation Plan for 2013-2016, the following Calls for Proposals will be launched during year 2013:

1. “Aerodynamic experimental development and investigation on innovative low noise A/C 90 pax configuration” (Ref.: JTI-CS-2013-1-GRA-02-020)

2. “Optimization and highly-accurate/reliable demonstration of low noise innovative Main Landing Gear” (Ref.: JTI-CS-2013-1-GRA-02-021)

3. “Experimental investigation of advanced load control/alleviation technology in a regional A/C” (Ref.: JTI-CS-2013-1-GRA-02-022)

4. “Development of methodology for structural and mechanical analysis on kinematics and actuators integration for aircraft high lift devices and load, control & alleviation devices” (Ref.: JTI-CS-2013-1-GRA-02-023)
Green Regional Aircraft

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) approach for the Future Regional Aircraft. The removal of hydraulic fluid will further contribute to achieve the goal of an environmentally 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 Years 2013-2016

Within the year 2014 the GRA3 will conduct and complete the 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. In parallel it will be completed the development 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). The activities will include the FTI introduction and the modification of A/C Electrical Power Generation for Demo purposes.

In 2013 is expected the delivery of the Shared Simulation Environment (SSE) to be used for the assessment and the optimisation of the Energy Management logics. In the same year is expected the release of final issue of the the “Validation plan for in flight demonstration of Energy Management” as well as preparation of flight tests procedures.

In the 2013 will also start the manufacturing of parts for the introduction of the A/C systems modifications as well as for FTI. During year 2014 activities will be essentially performed for the modification of the demo aircraft and installation of parts, equipment and FTI,

In parallel to Aircraft modification and equipment installation it will be performed the activities for preparation of the Flight Test plan, Then A/C ground test will be executed and prepared the documentation for the Flight clearance of the modified aircraft.

Finally in the 2015 the Flight test campaign will be conducted, results analysed and final reporting provided.

In details the following WPs will run:

- 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 WP is expected to complete in 2013 with the delivery of the Shared Simulation Environment (SSE) therefore the activities for the year 2013 will mainly be the following:
- Development of systems models of regional aircraft
  - Complete implementation of Level 2 and Level 3 simulation models
- SSE development
  - Integration of Level 1 (Architectural Level), Level 2 (Functional Level) and Level 3 (Behavioural Level) models into the SSE

**WP3.3.1 Future Aircraft Configuration for AEA:**

The WP started on 1st November 2009 to complete at end of 2014 (about 59 months). In 2013 and 2014 the activities will continue and complete the ones carried out during the year 2012, 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.
- Validation 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.
- Analysis and validation of Energy Management Functional logics for Future Regional Aircraft
- Development ground test for the validation of the analyses as well as for on-ground verification of the demonstrator configuration
- Contribution to the interim report for TE

**WP3.3.2 Demonstrator Configuration for AEA:**

The WP started at the end of 2010 to be completed in the 2013 (about 33 months). The activities for the year 2013 will mainly address the following points:

- Definition of on-board systems interested 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),
- Definition of FTI and of the modification of A/C Electrical Power Generation for Demo purposes.

**WP3.4 AEA Definition of Demonstration**

The WP is expected to end in the 2013 with the release of final issue of the the “Validation plan for in flight demonstration of Energy Management”.

**WP 3.5.1 Preparation of Flight demonstrator for AEA:**

The WP is expected to complete in the 2014. During 2013 and 2014 the activities will mainly address the following points:

- Design and manufacturing 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),
- New Electrical Power Generation for Demo Supply Channel,
- EMA’s Loads and associated Bench Test introduction on-board.
- Innovative FTI

- Validation of activities concerning Development and Manufacturing of innovative equipment (launched by CIP) to be introduced on A/C demo such as:
  ✓ Electrical Energy Management in flight demo Control Console and Electrical Power Center
- Preparation of the ground/flight test procedure on the basis of the Validation Plan

**WP 3.5.2 Flight Demonstration for AEA**

The WP is expected to complete in year 2015. The activities will essentially address the following:

- Modification of demo aircraft and installation of parts and equipment for demonstration
- Modification of demo aircraft and installation of parts and equipment for FTI.
- A/C ground tests execution
- Preparation of the documentation for the Flight clearance of the modified aircraft.
- Flight test campaign
- Analysis of results and final reporting

**WP 3.6 AEA analysis and final reporting**

The WP is expected to last about 9 months starting at end of the year 2014. In this period the activities are expected to perform the following:

- Life Cycle cost evaluation of Energy Management solution
- Performance analysis of energy management solution
- SSA and reliability assessment of energy management solution

**GRA3 - Calls for Proposals Years 2013-2016**

No CIP are currently planned for years 2013-2016.
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 are assessed and down-selected in SGO ITD and further development for the regional applications in GRA ITD. When ready the technologies are integrated in a Regional aircraft flight simulator. Finally, the simulator runs tests in order to assess the environmental benefits deriving from new green technologies.

In Clean Sky time-frame Alenia Aermacchi 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 Years 2013-2016

The activities planned for 2013-16 are:

- High Level Requirements for MTM (WP 4.1) – started in 2008
- Prototyping Tool for MTM functions (WP 4.3) – started in 2011
- Definition of Flight Simulator Demonstration for MTM (WP 4.4)
- Demonstration preparation & Test for MTM (WP4.5)
- MTM Analysis & Final Reporting (WP4.6)

WP4.1 High Level Requirements for MTM

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

The aim of this WP is to define:

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

The first release of the above documents was produced in 2010, in 2013-15 the preparation of updated version will be finalized, covering possible input coming from SESAR:

In these activities Alenia Aermacchi 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)

Preparation of updated version will be finalized, covering possible input coming from SESAR:

In these activities Alenia Aermacchi, Thales and Air Green are involved.
WP4.3 Prototyping Tool for MTM functions:
The aim of this WP is:
- to finalize ATM scenario model
- to finalize the final configuration of GRA flight simulator to be used for final assessment;
- to finalize the development of the final release of Green FMS
- to finalize the integration of all models in GRA flight simulator

In these activities Alenia Aermacchi, Thales and UniBO are involved.

WP4.4 Definition of Flight Simulator Demonstration for MTM

The aim of this WP is:
- to assess demonstration requirements and criteria
- to elaborate test cases and procedures

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

WP4.5 Demonstration preparation & Test for MTM

WP4.5.1 Preparation of Flight Simulator Demonstration for MTM:
The aim of this WP is:
- to configure GRA flight simulator in order to perform tests

WP4.5.2 Flight Simulator Demonstration for MTM:
The aim of this WP is:
- to run tests
- to prepare relevant reports

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

WP4.6 MTM Analysis & Final Reporting

The aim of this WP is:
- to analyze reports in order to assess the environmental impact reduction achieved w.r.t. GRA targets

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

GRA4 - Calls for Proposals Years 2013-2016

No CfP are currently planned for years 2013-2016.
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
  - 130 pax.

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 Years 2013-2016

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

✓ 2013
  - Turbo Prop A/C Configuration Final Sizing (Loop 3) & Green features evaluation
  - G-TF A/C Configuration Final Sizing (Loop 3) & Green features evaluation
  - A-TF A/C Configuration Final Sizing (Loop 3) & Green features evaluation
  - Completion of Aero-acoustic noise emissions measure for advanced Regional OR A/C configuration (WTT 3)
  - Trade-off studies for all A/C configurations studied.
  - GRASM (TP A/C 90 pax and the best G-TF A/C 130 pax updating)
  - Open Rotor A/C Configuration Final Sizing (Loop 3) & Green features evaluation
**Green Regional Aircraft**

**2014-2015**
- GRASM (TP A/C 90 pax and the best G-TF A/C 130 pax updating)
- Turbo Prop Final ASM Delivery
- GTF Final ASM Delivery
- Aerodynamic & Aeroacoustic WTT Large-Scaled A/C 130 Pax Model (WTT 5)
- Test results

**In details the following WPs will run during 2013-2016:**

- **WP 5.1 NC A/C High Level Requirement**

  **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, Turboprop and Open Rotor). During 2013 year the final requirements for Advanced & Geared Turbofans and Open Rotor engines to install on the future Green Regional Aircraft configuration will be specified.

- **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 A/C and engine requirements. Main system and structure architectures will be defined for such configurations.
  
  The main activity of 2013 year and during the first quarter of 2014 is the completion of the last loop of the Green Aircraft Preliminary Sizing that will generate the 3rd 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 Green Aircrafts. The ASM for the Turboprop 90 pax and for Geared Turbopan 130 pax will be updated yearly until 2015 year.

  **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 (Turbooprop, Advanced Turbopan and Pusher Open Rotor) in order to size the Green aircrafts configurations. Within 2013 Rolls Royce and Snecma will send independently the third and last set of engine data in order to supply the last loop of preliminary sizing and the last updating of Aircraft Model Simulation preparation to send to Technology Evaluation.

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

  This WP is devoted to optimize the Powerplant/Airframe integration for all Green aircrafts configurations studied (Turboprop 90 pax, Advanced and Geared Turbopan 130 pax, Open Rotor 130 pax). The optimization aims to improve green features (noise and emissions) taking into consideration aerodynamics and structures constraints. 2013-2014 activities will be focused on the 3rd loop of integration studies for Green Turboprop, Turbopan and Open Rotor configurations. Final CAD files will be finalized in order to supply the different GRA WTT campaign.

  **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...
Green Regional Aircraft

(emission and noise). Starting from main results of the Preliminary Sizing activities, 2013 year activities will be characterized by trade-off studies, highlighting pros and cons in terms of green features.

**WP 5.4.2 Configuration definition and test specification:**

This WP is devoted to define Green A/C configuration to be tested in the WT facilities (WP 5.5) and on preparation for WT test specification (aerodynamic and aero-acoustic tests).

Objectives tests, parameters to be measured and the flight conditions to be considered will be defined. The general geometrical characteristics of the model will be selected for the Low and High speed configuration and Acoustic one.

- **WP 5.5 Demonstration preparation and test for NC**

  **WP 5.5.1 Preparation of wind tunnel demonstration:**

  Aerodynamic & Aeroacoustic WTT Large-Scaled A/C 130 Pax Model (WTT 5 – Final NC domain demonstration) preparation with a detailed definition of the test programme (schedule), the selection of the measurement techniques and a possible support to the wind tunnel staff. General and detailed CAD model design, including a structural analysis and model manufacturing will be performed.

  **WP 5.5.2 Wind tunnel demonstration:**

  Aerodynamic & Aeroacoustic WTT Large-Scaled A/C 130 Pax Model (WTT 5) execution.

- **WP 5.6 NC analysis and final reporting:** During 2015 year a comparative analysis of the Green aircraft versus the Reference ones and ACARE goals will be performed. The comparison will be based on the theoretical (WP 5.2 and 5.3) and experimental ones (WP 5.5). Furthermore, the improvement identification and JTI technology innovations assessment for future Regional Green Aircraft will be performed.

**GRA5 - Calls for Proposals Years 2013-2016**

No CfP are currently planned for years 2013-2016.