Clean Sky

Skyline

Innovation takes off

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Green light for Clean Sky 2

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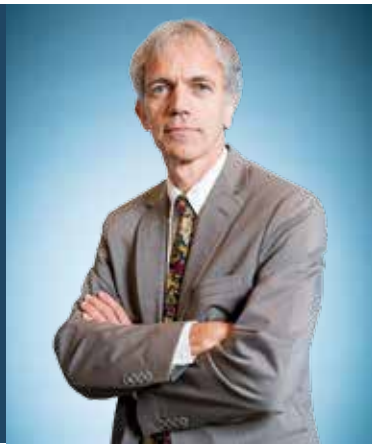
Editorial

Eric Dautriat
Executive Director
of the Clean Sky Joint Undertaking



Green light for Clean Sky 2: on 6 May, the Council of the European Union adopted the Regulation putting in place the new Programme and implementing the Joint Undertaking continuation up to 2024. Almost €4bn in total will be dedicated to the new projects, ranging from large aircraft to general aviation. The first Call for Proposals, intended to recruit a first wave of "Core Partners", which will become full Members of the Joint Undertaking, will be launched on 9 July, when President Barroso officially launches the second generation of JTIs. On 22 May at ILA Berlin, we already celebrated this green light with a widely attended conference, introduced by Ric Parker, newly elected Chairman of the Clean Sky Governing Board. Christian Ehler, MEP, rapporteur for Horizon 2020 and for Clean Sky 2, gave a very supportive speech. His unconditional support for innovation no doubt contributed to his reelection!

Christian Ehler strongly emphasised the European Parliament objective to see Horizon 2020 research connected with the use of EU Structural Funds. Striving for such a synergy is now part of the remit of the Clean Sky JU, clearly identified in the Regulation. This is an essential opportunity for R&D budgets to increase their leverage effect - through the funding of research infrastructures by Structural Funds for instance. This will require political support at all levels, and also the involvement of Clean Sky participants.

"Additional activities" performed by Clean Sky Members are already supporting the new Programme; this is the consequence, and the demonstration, of the pivotal role, or rallying point, that Clean Sky 2 is destined to play. Moreover, as written in the Clean Sky 2 Regulation, the Council has endorsed that the National States Representatives Group act as an interface with the JU "*on the status of relevant national or regional research and innovation programmes and identification of potential areas of cooperation*".

Sharing common objectives, building complementarities, and joining forces as much as possible will give European aeronautics a wider competitive edge and together we will realise the 2050 environmental goals.

Noise is, of course, part of the Clean Sky 2 objectives, as it is already in the current Clean Sky. We did not highlight the activities dedicated to noise enough. Nor did we adequately celebrate the achievements already made. In this Skyline issue, we summarise some of the wind-tunnel tests performed during the past few years, and the very promising results we obtained. It is clear now that Counter-Rotating Open Rotor noise levels will be quite close to the next generation turbofans, and significantly below the current levels; fulfilling the upcoming set of ICAO/CAEPE requirements. This is truly a major breakthrough: a major achievement of Clean Sky and other complementary programmes.

Noise reduction projects were also well reported in the three-day technical conference organised in Brussels in March by AAAF, with the support of CEAS: "*Greener Aviation 2014: Clean Sky breakthroughs and worldwide status*". A paper by CIRA and several other participants won the Conference award.

I am already dreaming about exciting presentations about Clean Sky 2 should another conference be held in two years' time. We would hear stories about ambitious, game-changing technology demonstrators, , such as hybrid propulsion, hybrid laminarity, morphing wings, ultra-high bypass ratio engines, continuation of the Open Rotor for flight testing, or fast rotorcraft. In the meantime, many Members and Partners will have been selected: they will be contributing to presentations and technical debates leading to research organisations and industry working together.

The European election results reflected growing euroscepticism. I'm convinced that the JTIs are the best example of what the European Union is able to do for synergising European talents, supporting the industry, and creating jobs. This is our "raison d'être" in this outstanding sector of excellence.

Eric Dautriat

Clean Sky 2 Speeds Ahead

Ron van Manen
Clean Sky Technology Evaluator Officer and Programme Manager for CS2 (acting)

Aeronautical engineers among our readers (I assume there are quite a few of you) will know V_R, or "V-Rotate" as the speed, or *velocity*, at which the aircraft commences a rotation while still racing down the runway in order to increase lift over the wings and become airborne. As I am writing this update, so too is Clean Sky 2 at its point of rotation – lifting nose-wheel first and then all wheels off the runway and taking flight.

A common misunderstanding is that the aircraft has already reached its flying speed when this rotation commences. In actual fact, for an important few moments acceleration continues with engines at take-off thrust until the airspeed needed for flight is reached and the aircraft becomes unstuck (I admit – one of the least elegant official aeronautical terms but nonetheless descriptive). So too has Clean Sky 2 continued to gain speed after the event at ILA Berlin announcing the Programme's take-off, progressing along the runway nearing the point of starting the Programme's flight path over the next decade of operations.

With the adoption by the Council of the European Union of the Regulation on Clean Sky 2 in May (together with all so-called Article185 and 187 initiatives, meaning in practice all JTI extensions under Horizon 2020; and other Joint Undertakings and PPPs such as - importantly - SESAR 2020), the Regulation will have come into force when this Skyline is published. In parallel with the other JTIs, Clean Sky 2 will open its doors to the participation of new Members via the first *Call for Core Partners* on 9th July.

In lifting off as CS2, the ongoing acceleration I have referred to consists of reaching a number of key milestones that lie between the Regulation's entry into force in late June and its becoming airborne (or rather operational) as a Programme, and indeed as a renewed Joint Undertaking.

The first key step consists of the adoption of the revised Statutes of the Joint Undertaking by the "Private Members": both the CS2 Leaders and the current Members of the JU involved in Clean Sky (Leaders and Associates).

A new Governing Board convened directly upon the entry into force of the Regulation, and after adopting its Rules of Procedure, it commences operations as the governing body of the JU from late June. One of its first important steps is the adoption of the first Work Plan of the JU encompassing both the ongoing Clean Sky Programme and the first operational activities within the new Clean Sky 2 Programme. This Work Plan encompasses the 2014-15 high-level plan for executing the two programmes; and for CS2 it defines not only the (technical) tasks envisaged by the Leaders, but also includes the Topics for the Calls through which the CS2 Programme will be open to participation.

With the adoption of the Work Plan and based on the finalised CS2 Joint Technical Programme [or JTP] – the first Grant Agreements are now being finalised, enabling the Leaders to commence executing the first steps of the actual CS2 (technical) Programme.

Then, and by far the most important next step in getting fully airborne: the first *Call for Core Partners* opens from the 9th July 2014. Detailed *Strategic Topics* that define the membership and participation roles sought for the Programme can now inform potential applicants on the areas for which Core Partners will be selected in this first wave of new Members. Together with this, the Rules for the Submission, Evaluation and Selection of Proposals as adopted by the Governing Board will guide potential applicants in terms of preparing and submitting proposals. The Call Fiche including the Strategic Topics and these Rules, plus a detailed overview of the full Programme via the JTP, will be available. This marks a true first in terms of openness and transparency: a technical roadmap as currently foreseen over the full life of the CS2 Programme can be evaluated by all parties considering an application to participate. Never before has the European Aeronautics research space been worked into a decade long roadmap and published - with the goal of ensuring the broadest participation of relevant and capable stakeholders across the EU and Associated Countries. As stated (literally) in the Clean Sky 2 Statutes, this constitutes a clear commitment to create a true "Clean Sky 2 Community" across the full spectrum of research actors and contributors, wherever the joint goals and objectives are supported. Thus, the publication of the JTP and the opening of the first Call mark the opening of the CS2 Programme for broad participation based on winning proposals and a successful inclusion of the work content from the winning applicants.

So – returning to my opening statement: the coming months mark the further acceleration on the Clean Sky 2 take-off roll. Nonetheless, with the adoption by the Council in May and the entry into force of the Regulation in late June flight preparations have ended, the take-off role is underway and the flight of Clean Sky 2 is set to begin.

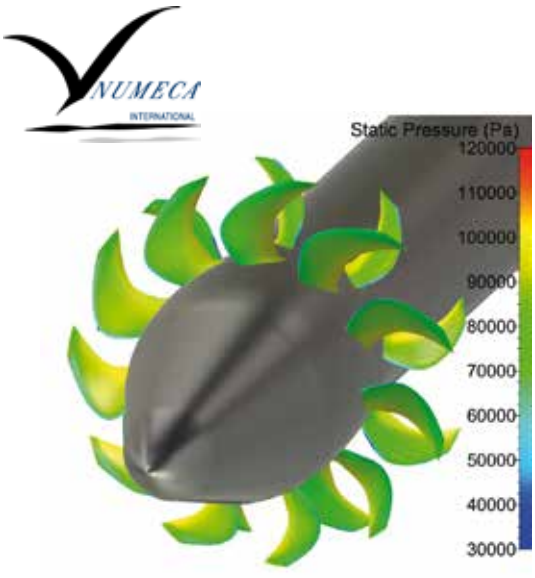
Belgian expertise within Clean Sky

Charles Hirsch
President of NUMECA Int.

Founded in 1993, as a spin-off of the Vrije Universiteit Brussel (VUB), NUMECA has more than 20 years of market presence, 400 prestigious and multinational customers worldwide, and a team of 120 highly skilled employees, PhD and MSc Engineers, 85 of whom are based at the headquarters in Brussels. NUMECA is a leading and innovative company in advanced simulation technology, providing a large range of software and services in computational fluid dynamics (CFD), multidisciplinary design optimisation, multiphysics, and acoustics.

Four Calls for Proposals have been awarded to NUMECA, leading to a very productive interaction with Clean Sky core partners. NUMECA is also looking forward to participating in Clean Sky 2, stimulating its potential in software development and applications.

In 2009, we submitted our first Call for Proposal, entitled "*Theories and Numerical Code for Prediction of Near and Far Field Noise Generated by New Generation Propellers and Open Rotor Blades*" (CAA-NLH). This dive into Clean Sky kicked off collaboration with the GRA-ITD leader Alenia Aeronautica on the aerodynamic and aeroacoustic properties of counter rotating open rotors (CROR). Through this project, we adapted and coupled an acoustic (CAA) tool with a powerful new CFD approach that provides a significant gain in CPU time compared to traditional CFD methods for unsteady flow simulations. With this major technological breakthrough, the cost and the time of a CFD/CAA simulation has been significantly reduced. As such, many more design options can be analysed, increasing the possibilities for identifying optimum configurations within a limited design time framework.



Taking advantage of our experience gained in the above Call for Proposal, we collaborated with the von Karman Institute through the project "*Design of Innovative Counter-Rotating Open Rotor Blade and Pylon*" (DINNO-CROR). With the guidance of the SFWA-ITD leader Airbus we combined an experimental investigation of two, low TRL flow/noise control options, associated with the innovative and highly efficient numerical CFD/CAA approach. The configurations studied with the porous blade concept and pylon scooping concept allowed the SFWA-ITD partners to restrict the field of investigations for future concepts which should be further developed to a higher TRL for limiting the aeroacoustic impact of the CROR.

We continued the collaboration with Airbus through the project "Numerical Aeroacoustic Assessment of Installed Counter-Rotating Open Rotor Power Plant" (NAA-CROR), still ongoing. We concentrate our efforts on the validation of our numerical results and on the comparison with the numerical and experimental results from the SFWA-ITD partners. The numerical simulations of NUMECA Int. rely on the nonlinear harmonic method, which allows a gain in CPU performance of two to three orders of magnitude compared to current CFD sliding grid or Chimera methodologies. Harnessing the results from the above projects, we developed a fully integrated solution dedicated to open rotors in the software products FINETM/Turbo and FINETM/Acoustics, where we also incorporated the option to model porous liners on patches with prescribed impedances.

In addition to the work on open rotors, the just-completed GRA project "*Efficient CFD Multi-Physics Programming Research*" (E-CFD-GPU), was aimed at developing a new approach of a complete high fidelity CFD multiphysics computational chain, with a drastic reduction of the turnaround time. Tools such as HEXPRESSTM/Hybrid, the convergence acceleration modules and its extension to transition and unsteady flows have shown impressive improvements on different stages of the computation chain. The use of graphics processing units (GPU) is a relatively new approach in high performance computing and will be further investigated and pursued in the future. Finally, significant efforts are still ongoing towards a simplified environment and more efficient algorithms for a unified multiuser multiphysics platform that takes advantage of modern hardware architectures.

Greener Aviation: Mission possible

La Société Savante
de l'Aéronautique et de l'Espace

The conference Greener Aviation: Clean Sky breakthroughs and worldwide status, organised by 3AF together with CEAS and supported by Clean Sky, took place from 12 to 14 March in Brussels. Some 300 participants were presented with 120 papers covering a wide range of green aviation technology, developed mostly within the Clean Sky programme, but also worldwide. The programme featured Robert-Jan Smits, Director General of DG Research and Innovation, Manuela Soares, Director of Transport, DG RTD, and Margus Rahuoja, Head of Cabinet of the Transport Commissioner Siim Kallas. Ric Parker, Chair of the Clean Sky Governing Board, Eric Dautriat, Clean Sky Executive Director, ACARE chairman Peter Hartman and Michel Scheller, 3AF President also addressed the audience. Along with the presentation of different papers, the conference offered round tables for composite vs. metallic structures, Open Rotor and Turbofan, as well as the role of alternative fuels and their possible implementation in the sector. At the three-day conference, the Greener Aviation Award was presented to the 'Airframe noise reduction technologies applied to high-lift devices of future Green Regional Aircraft' paper, prepared by an international team and presented by Ignatzio Dimino, CIRA.

"The work of the Clean Sky Joint Undertaking is crucial in developing breakthrough technologies to significantly improve the environmental performances of aircraft, engines, systems and components. This results in quieter and more fuel efficient aircraft."

Peter Hartman

"A new set of environmental targets, but also continued or improved global leadership, and a contribution to enhancing European mobility, this is what we will be working for within the Green and Smart Transport pillar of Horizon 2020."

Eric Dautriat

ONERA and SAFRAN Aircelle win Best Communication Award

ONERA and SAFRAN Aircelle have won Best Communication Award for the 48th International Symposium of Applied Aerodynamics. The award was received at the 49th Symposium in April 2014.

The paper written by ONERA and SAFRAN Aircelle, Clean Sky Associate Partner and ITD leader respectively, deals with research activities performed in the framework of SFWA-ITD. It describes the numerical design of laminar nacelle engines using two control strategies: i) passive - via design shaping referred to as **N**atural **L**aminar **F**low (NLF), ii) active - via wall suction known as **H**ybrid **L**aminar **F**low **C**ontrol (HLFC).

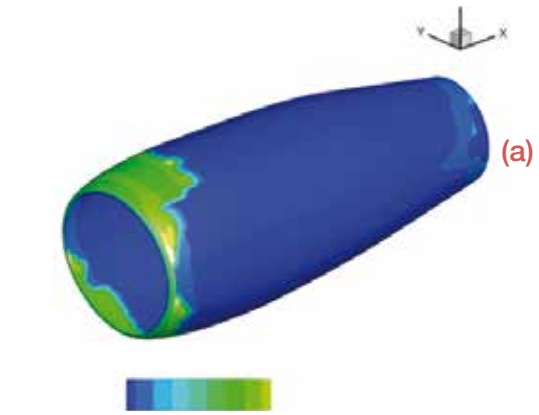
Engine nacelle represents around 6% of the total drag of an aircraft and its friction accounts for 60% to 70% of the overall drag. Thus a laminar nacelle could lead to a maximum of a 2% reduction of fuel consumption.

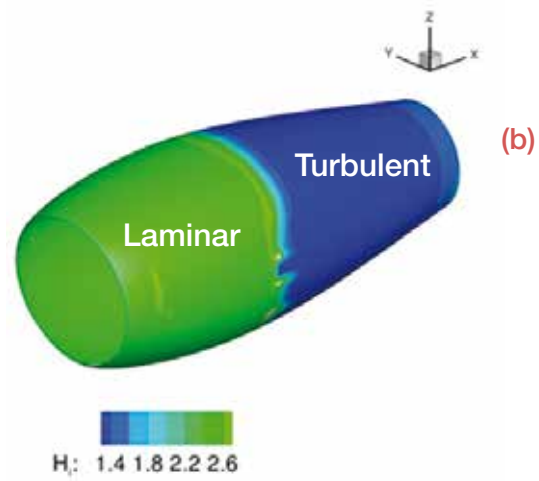
Numerical simulations, based upon Euler computations and stability analyses, pointed out the impact of some parameters on triggering laminar-turbulent transition areas. For instance, mean flow distortion (due to pylon or wall suction) and surface imperfections (rivets, steps, gaps, waviness, etc…) might trigger this transition. An illustration of laminar/turbulent extents from NLF design is provided in Fig. 1, where green and blue colours represent laminar and turbulent flow conditions respectively. Shape optimisation had been completed to the fully installed configuration, comprising wing and pylon.

Award ceremony. From left to right: X. Bouteiller (Safran/ Aircelle), Jean Delery (3AF/Scientific Committee Chairman), J. Reneaux (ONERA, representing O. Vermeersch).

More information is provided in the 2014 publication Vermeersch, O. and Bouteiller, X. 'Numerical study of laminar nacelles: natural and hybrid laminar flow designs', International Journal of Engineering Systems Modelling and Simulation, Vol. 6, Nos. 3/4, pp.191–204. (2014).

Extent on laminarity due to shape optimisation: reference nacelle (a), optimized NLF geometry (b).





SFWA-ITD BLADE: Proof of Laminar Flow

Helmut Schwarze
SFWA Project Officer, Clean Sky JU

It is an old dream of Aerodynamic specialists to reduce drag by maintaining natural laminar flow conditions for a substantial part of the airframe surface during most of the mission flight time. This dream has been around for decades and has even been tested with full scale demonstrators several times, but up until now no aircraft manufacturer has succeeded in realising it on an actual serial civil transport aircraft design of the >100 passengers class. Nonetheless, maintaining laminar flow is the most promising aerodynamic means of considerably reducing drag and therefore CO_2 emissions without the disadvantages of changing the overall layout of the aircraft. However, the operational suitability and affordability during daily flight operations still has to be proven.

In the SFWA-ITD of Clean Sky one of the most prominent demonstrations is trying to close this gap and to provide the functioning of the natural laminar flow wing concept under real operational conditions at full scale. In the BLADE (Breakthrough Laminar Aircraft Demonstrator in Europe) project, both wing tip ends (spanning approximately 8 metres on each side) of an Airbus A340 (MSN01) will be replaced by a completely new laminar wing design. Two different layouts have been chosen: a highly integrated SAAB composite design for the port side and a composite upper wing cover combined with a metallic leading edge designed and manufactured by GKN for the starboard side. Achieving and keeping the extremely tight tolerances in geometry and surface quality during manufacturing in order to sustain laminar flow is one of the key challenges in realising the concepts. Structural design has to be outlined accordingly. This involves not only the design, but also the manufacturing of the parts, the installation on the aircraft with the respective tools, ensuring the operational flight envelope of the aircraft even under 'slatless conditions' and gaining the flight permit fulfilling all the stringent flight safety requirements - a tremendous task

> "As we all know, to prove the laminar flow during flight is a real challenge."

In addition to this, appropriate diagnostic and measurement equipment has to be installed onto the test aircraft in order to visualise and therefore detect the areas of the laminar flow boundary layers.

Presently 150 - 200 flight hours are planned. Needless to mention that a €100 m project like this one can only be managed under the professional lead of a competent aircraft manufacturer. BLADE is led and managed by Airbus in cooperation with a lot of companies and institutes around Europe. Most of them you will identify in the attached picture. By the way, if the concept of Clean Sky as a public private partnership was and is a novel 'item under test', - which is presently proving its efficiency, - it is even truer for BLADE.

> "Such a big project, aiming to perform a flight test campaign with one of the biggest aircraft in civil aviation, was never performed under European research rules."

So, where are we at the moment? After a long and crucial design phase we are now in the phase of releasing the drawings to manufacturing. Before doing so, not only did new wing designs have to be performed, but the proof of flight safety requirements also had to be harmonised in order to comply with the rules of the aircraft holder (Airbus). Requirements had to be scrutinised and adapted repeatedly.

All relevant parts will have to pass this process until the end of 2014. Respective actions have to be closed before manufacturing of key elements can be initiated. This is one of the most important milestones, as by doing so, material

will be ordered, manufacturing will start and modifications cannot be introduced any more. The latest wind tunnel tests will be performed and analysed in parallel, and flight tests with the test aircraft will continue in order to achieve a sound reference status of the aircraft and ensure the correct functioning of the whole system.

All tooling has to be prepared in order to be ready for assembling the parts on ground (at Aernova in Spain) before both outboard sections are transferred to Airbus for installation on the aircraft. Again, the respective tooling has to be designed, manufactured and tested. Limit load test with the installed wing sections on the aircraft will follow after getting the approval of the certification units. A limit load test on a flying test bed is quite challenging to say the least. Not to forget the flight test instrumentation! It is not only the hundreds of test parameters which will be recorded during all test flights, but the visualisation of laminar flow has to be achieved as well. The principle via infrared camera technique was already proving its capability during flights with a Dassault Falcon 7X, starting already in 2010/2011. But the dimensions on the A340 are quite different and the task in itself is not a standard one. Just recently in January 2014 the idea of installing a camera pod at the top of the A340 fuselage had to be rejected in favor of an installation at the vertical tail tip. The pod design was very complex and limited the aircraft mission envelope too far. In order to guarantee the observation of the leading edge at the outboard sections under test an additional camera will have to be installed in the fuselage looking at the respective leading edge wing sections. In order to get all things done on the huge test aircraft, a new hangar will be made available. Presently a new one is in discussion, which will be erected in Tarbes, south of Toulouse in France. The foundation stone ceremony took place in April 2014. At the beginning of 2015 the aircraft will be placed there with the respective working party in order to start modifying the wing and systems. The first flight is now planned at the end of 2016.

The project is structured in an extremely challenging way not only regarding the research targets, but also regarding the different kinds of partners involved with its specific contracts, the different requirements and priorities as well as the overall contractual framework! A lot has already been achieved, but a lot is in front of us! Keep your fingers crossed, but I can assure you that the whole team is highly committed to making it happen!

The Newcomer to Clean Sky 2: Small Aircraft Transport

The initiative of Small Aircraft Transport (SAT) in CS2 represents the research and technology interests of European aircraft manufacturers of small aircraft used for passenger transport (up to 19 passengers) and for cargo transport, belonging to EASA´s CS-23 regulatory base. The small aircraft community interested in CS2 is a group of more than 40 industrial companies (incl. many SMEs) supported by tens of research centres and universities. The community covers the whole supply chain, i.e. aircraft integrators, engine and systems manufacturers and research organisations.

Based on the documents published within the European CSA projects, EPATS (European Personal Air Transportation System) and SAT-Rdmp (Small Aircraft Transport – Roadmap), and inputs from completed or currently running FP6/FP7 projects (namely level 2 projects CESAR, ESPOSA, Actuation 2015 and level 1 projects SAFAR, INFUCOMP etc.), technical areas which support the achievement of CS2 goals were selected. To date, most key technologies for the future small aircraft have reached an intermediate level of maturity (TRL3-4). They need further efforts to reach a maturity level of TRL5 or TRL6 through both analytical and experimental demonstration as transversal activities of CS2 ITDs.

Research areas were defined by aircraft and systems manufacturers which have prepared to develop, validate, and integrate the aforementioned technologies through dedicated ground and flying aircraft demonstrators. For some countries, the small aircraft initiative in CS2 research is the most effective way to contribute to high level R&D.

Who are the leaders of SAT in Clean Sky 2?

Evektor(Czech Republic) is a private commercial organization with highly-educated and skilled engineers. It is a leading design company in the Czech aerospace industry covering complete product development, testing, and certification. Its earlier successful participation in many other aerospace projects has flown into a contraction of its own project, EV 55 Outback - twin-engine turboprop. Evektor's subsidiary Evektor–Aerotechnik is one of the world´s largest manufacturers of light sport aircraft, advanced UL and very light aeroplanes. It hasover 40 years of experience in aircraft manufacturing, EASA certified production, and a sales network in 40+ countries all around the world.

Piaggio Aero Industries (Italy) is an EASA (European Aviation Safety Agency) approved aircraft design and production organisation. Piaggio Aero Industries is managing the complete aircraft life cycle from pre-design, design, certification, production as well as the after sales support such as aircraft repairs and spare parts. Piaggio currently

manufactures the P180 Avanti II, the Company flagship product, a twin-engine, turboprop executive aircraft powered by two pusher turboprops. The P180 is the fastest turboprop in production, more than 230 of which have been delivered worldwide. The workforce is today made up of 1,300 people and the company had a 2013 turnover of €160 million, 24.5% of which is invested in R&D activities.

Core Partner Candidates

Potential core partner candidates for small aircraft ITDs (airframe, power-plant, systems) belong to a large community interested in contributing to developing and integrating CS2 research activities. These partners will focus their actions to match industrial and research interests concerning technology areas related to small aircraft.

Major breakthroughs in Open Rotor noise reduction

Rasika Fernando
Acoustics R&T engineer, SAFRAN Snecma

Clean Sky is the main contributor in reaching the bar set by the Advisory Council for Aviation Research and Innovation in Europe (ACARE) on noise and gaseous emissions. The goals are to cut carbon dioxide (CO2) emissions by 50% and perceived noise by 10 dB per aircraft operation, between the year 2000 and 2020. Aircraft engines, transforming fuel energy into thrust, CO2 and NOx bear a large part in these objectives, and particularly those powering short and medium range (SMR) commercial airliners.

Among the different options of future SMR engines, the Contra-Rotating Open Rotor (CROR) offers the best potential in terms of efficiency and fuel burn reduction that could be as high as 40 percent. However, in order for this architecture to see the light, an important challenge regarding rotor noise radiation has to be faced. Indeed, while enabling a dramatic increase of the bypass ratio and the engine performance, the absence of casing and nacelle also limits blade-off protection and noise shielding possibilities. It is only through extensive technology studies and validation that these hurdles can be overcome, and Clean Sky is the right setting to work on such matters.

Since the middle of the last decade, Snecma has put much effort in research on the CROR technology and the preparation of its SAGE2 (Sustainable and Green Engines) demonstrator that will be tested on the ground by the end of 2015. With the help of high-fidelity computer simulations and multi-criteria optimizations, acoustics and aerodynamics engineers at Snecma have been tackling the difficult task of designing quieter and more efficient rotors. In order to validate the successive generations of propeller blades, Snecma has built HERA (Hélices Rapides), its own 1/5th scale Open-Rotor rig for wind tunnel testing.

HERA is a high-pressure air driven rig that is equipped with all the appropriate instrumentation for aerodynamic and mechanical behavior measurements, such as pressure and temperature sensors, stress gauges and Rotating Shaft Balances developed by Onera. It has therefore the capability to provide accurate and reliable data for Open Rotor blade evaluations and blade design software validation.

The first HERA tests were performed in 2011 at the Onera-S1MA closed section wind tunnel in Modane, France. For quality far field acoustic measurements, the test section walls were fitted with foam panels preventing sound reverberation. In three years, Snecma has tested both acoustics and performance of three generations of « in-house » blade designs with the HERA rig, on a wide range of operating points. Isolated low speed tests that were performed at Onera-S1MA and at the DNW-LLF wind tunnel in the Netherlands have focused on far field acoustic measurements for community noise evaluation purposes, whereas high speed tests up to Mach 0.78 at Onera-S1MA provided an extensive set of both aerodynamic performance and near field acoustic data, useful for cabin noise assessments.

The effects on performance and acoustics of rear mounted (pusher) and wing mounted (puller) aircraft installations have also been investigated at low speeds during tests at the DNW-LLF with Airbus' Z08 model rigs and HERA fitted with Snecma blades. These have proved to be very efficient in offering a better understanding of how rotors behave in a more realistic environment and particularly, how the risk regarding pusher pylon wake and front rotor interaction noise can be mitigated thanks to a wake cancelling technology.

A significant amount of progress has been made since Snecma's 2008 aerodynamic blade design, up to the latest aero-acoustic design tested in 2013. Community noise has been reduced by almost 8 dB (cumulative level), while increasing rotor efficiency by 1.6 points at high speed. This is where Snecma stands today: the Open-Rotor technology is compliant with ICAO Chapter 14 community noise regulations and is therefore a viable option for future aircraft propulsion. Nevertheless, many challenges are still to be faced for the CROR technology

Farnborough INTERNATIONAL AIRSHOW
14-20 JULY 2014

Clean Sky Demonstration Stand

FROM 14 TO 18 JULY 2014

Clean Sky will be present at Farnborough Airshow 2014, giving the visitors an opportunity to see a wide variety of hardware such as an open rotor mock-up, a composite blade, a mock-up of the upcoming A340 flying test bed for laminar wing, innovative systems and much more.

Do not miss **Clean Sky Stand** at **Innovation Zone stand 4/IZ/A1**

www.cleansky.eu

Clean Sky and the L2 Actuation 2015 project

ACTUATION 2015 is an FP7 Level 2 collaborative project with a budget of €33m, to be implemented in 3 years (2011-2014). The consortium is composed of 53 partners, with EADS IW and University of Nottingham both in Clean Sky and in Actuation 2015.

The aim of the project is Standardisation and Modularity of actuators, with Mutualisation of effort across all actors in the sector and five demonstrators are considered.

The third coordinating meeting took place on 16 May in Brussels.

The main agreed actions concern the interchange of progress between Actuation 2015 and Clean Sky. Exchange of specifications and potentially of hardware may be considered in the framework of Clean Sky 2.

Read the latest Clean Sky facts and figures. Stay updated with our events on www.cleansky.eu

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