LEMCOTEC

LOW EMISSIONS CORE-ENGINE TECHNOLOGIES

# EU co-funded technology programme LEMCOTEC is taking-off

First year component specifications and concept definition

- **Targeting CO2 and NOx reduction through ultra-high pressure-ratio core-engine technology development**

In October 2012 the first year of the project will be completed and the project office has started to organise the upcoming Month 12 internal review. In the first year the work was focussed on the definition of the component specifications, preliminary concepts and on the generation of engine cycle performance decks.

While the cycle optimisations for both, regional **RTF** and large turbo-fan **LTF** configurations are still on-going this process has been completed for the mid-size open-rotor **MOR** core-engine. The generic aircraft model, for which this geared open-rotor engine has been modelled, has a design range of ~ 3,000 Nautical Miles, would cruise in ~ 35,000 ft altitude at ~ 0.75 Mach number with tail installation. The two-shaft core-engine technology status is consistent with entry into service in 2025. There is no Year 2000 reference aircraft for open-rotor engines. Consequently, the LEMCOTEC engine contribution to mission performance has been assessed relative to the open-rotor configuration in DREAM, based on a Year 2017 aircraft technology level.

It was found in the engine performance studies that the maximum OPR would be around **55:1** instead of the originally targeted overall-pressure-ratio of 60:1 for the selected engine technology and core-size. The reason is that the performance gain at higher OPR by better thermal-efficiency is outweighed by much higher increase of efficiency losses in compressor and turbine and by cooling air requirements in the high-pressure turbine.

The result of these calculations is that this engine configuration would have an advantage of ~ 2.5% SFC over the DREAM status. It has to be noted that this would be better than the originally targeted 2% SFC improvement. Translated to the usual year 2000 reference the expectation is that this configuration could reduce the fuel burn by ~ 30% on the engine level, as originally estimated more than 2 years ago.

The performance decks for the engine configurations (i.e. RTF, MOR, LTF) are required to optimise the definition of the requirements for component level, such as compressors, combustors and hot section for instance. These preliminary performance study results confirm that there are high-technology options available which can be used to reduce the environmental impact from future aero-engines.

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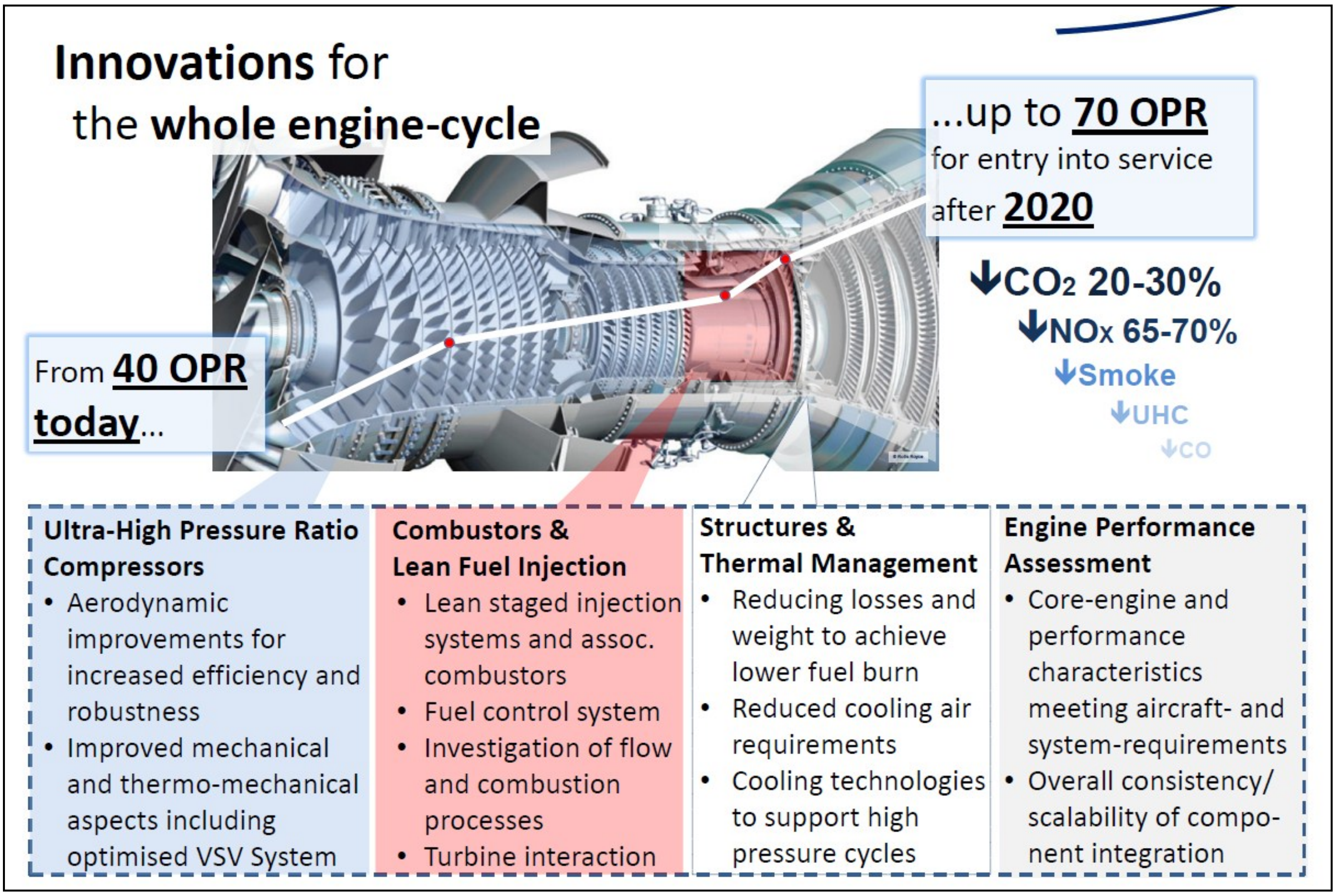
Specifications for the conceptual study engines with intercooling and combined intercooling and recuperation have been assembled, with an emphasis on the heat exchanger performance. For instance, according to the study engine performance deck, the intercooled and geared large Turbofan engine - for the selected technologies and core-size - would have an OPR of ~ **67:1** at take-off and up to OPR ~ **79:1** at climb condition. The overall target is to achieve a 2% better fuel burn than the 4% improvement targeted in NEWAC. The difficulty is the design, weight and integration of the intercooler. This work is still at a very low Technology Readiness Level.

OPR Overall Pressure Ratio
SFC Specific Fuel Consumption
RTF Regional Turbo-Fan
LTF Large Turbo-Fan
MOR Mid-size Open Rotor
FP6 C3 NEWAC - **NEW A**ero engine **C**oncepts (FP6 030876)
FP7 C2 DREAM - vali**D**ation of **R**adical **E**ngine **A**rchitecture syste**M**s (FP7 211861)



Potsdam, 25 October 2011

The new European technology programme LEMCOTEC (Low Emissions Core Engine Technologies) held its first workshop in Potsdam, Germany, on 24th/25th October 2011. The programme is led by Rolls-Royce Deutschland and was officially launched on 1st October 2011. This new research project, which is being co-funded by the EU under its 7th Framework Programme, commands an overall budget of 68.5 million Euros and will run for four years. LEMCOTEC aims to reduce $CO_2$ emissions by at least 20% with a potential reduction of up to 30% as well as $NO_x$ emissions by at least 65% with a potential reduction of up to 70% on the engine level, compared to technology and standards from the year 2000 through improvements of the engine architecture.

By driving towards these goals LEMCOTEC will play a key role in attaining and exceeding the engine contributions to the aims set out in the ACARE 2020 (Advisory Council for Aeronautical Research in Europe) strategic research agenda. Besides Rolls-Royce Deutschland, there are 35 different European partners involved in the project, including SNECMA, MTU Aero Engines, Rolls-Royce plc, Volvo Aero, ITP, Avio, Turbomeca, the German and French national aerospace research centres, DLR and ONERA, and leading European universities in the field. These partners are working together to develop new compressor technologies to achieve ultra-high overall pressure ratios of up to 70:1 (significantly higher than aero engines in service today), improving the combustor and developing new engine structures to cope with significantly increased pressures. The approach is to validate the potentials of the new technologies and bring them to maturity ready for introduction into new engine demonstrator projects. Dr. Ralf von der Bank, Coordinator of the LEMCOTEC Research Programme, said: "Increasing the thermal efficiency by increasing the overall pressure ratio of the aero engine up to 70:1 is technically a very ambitious way to reduce $CO_2$ and $NO_x$ emissions. LEMCOTEC will be a key element for the aviation industry to attain and perhaps exceed the environmental targets set in the ACARE vision for 2020." LEMCOTEC continues the efforts of the NEWAC (core engine up to overall pressure ratios of 50:1 without intercoolers) and DREAM (ultra-high bypass ratios with open rotor engines) programmes. It also complements and interacts with the SAGE programmes set up in the Joint Technology Initiative CLEAN SKY. LEMCOTEC aims to provide the European aero engine industry with a complete inventory of available and meaningful technologies to use in the development of future engines.

**List of Partners (in alphabetic order):**

Aristotle University of Thessaloniki (GR)
ARTTIC (FR)
Avio (IT)
Bauhaus Luftfahrt (DE)
Cambridge University (UK)
Central Institute of Aviation Motors (RU)
CERFACS (FR)
Chalmers Tekniska Högskola (SE)
CNRS-CORIA (FR)
Cranfield University (UK)
Deutsches Zentrum für Luft- und Raumfahrt (DE)
Ergon Research di Lorenzo Tarchi (IT)
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung (DE)
Fundación Centro de Tecnologías Aeronáuticas (ES)
Industria de Turbo Propulsores (ES)
Karlsruher Institut für Technologie (DE)
Loughborough University (UK)
MTU Aero Engines (DE)
Office National d'Études et de Recherches Aérospatiales (FR)
PCA Engineers (UK)
První Brněnská Strojírna - Velká Bíteš (CZ)
Rolls-Royce (UK)
Rolls-Royce Deutschland (DE)
RWTH Aachen (DE)
SNECMA (FR)
Technische Universität Braunschweig (DE)
Technische Universität Dresden (DE)
Turbomeca (FR)
Universidad Politecnica de Madrid (ES)
Università degli Studi di Firenze (IT)
Universität Stuttgart (DE)
University of Oxford (UK)
Volvo Aero Corporation (SE)
von Kármán Institute for Fluid Dynamics (BE)
Výzkumný a Zkušební Letecký Ústav (CZ)
WSK "PZL-RZESZÓW" (PL)

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