November 3, 2021

FAA CLEEN III Consortium Industry Day

GE Aviation

GE Aviation: Committed to a more sustainable future for aviation

Products

Developing and maturing technology solutions to dramatically reduce aircraft emissions

Industry Partnerships

Partnering globally to shape and guide industry dialogue and actions

Operations

Accelerating efforts to achieve carbon neutrality in our facilities by 2030

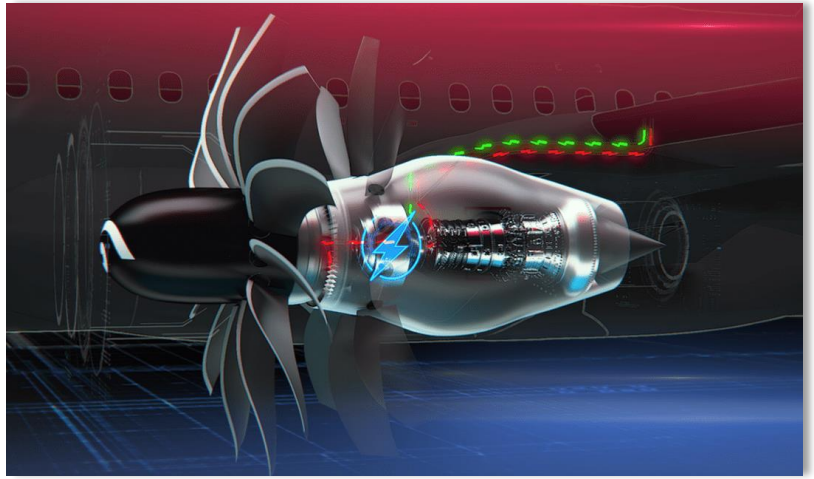
CFM RISE Technology Demonstration Program

TARGETING MORE THAN 20% LOWER CO_2 EMISSIONS

- Advancing open fan architecture
- Propulsive efficiency step change
- Same speed & cabin experience
- 300 separate builds in test plan
- Ground and flight tests mid-2020s
- Advanced materials
- Hybrid-electric capability
- Additive manufacturing
- 100% SAF, hydrogen capability
- EIS by mid-2030s

Revolutionary Innovation for Sustainable Engines

CFM RISE Technologies



Anticipated Benefits

- Noise: 13 EPNdB cum margin relative to Stage 5
- Combined Fuel Burn: 20+% reduction relative to current CFM LEAP* engine
- Targeting NOx reduction for a future high overall pressure ratio engine cycle, equivalent to 70% margin to the CAEP/8 standard at 30 OPR

Objectives

- **Open Fan**: develop unducted single fan architecture
- **Low emissions combustor**: develop low NOx and nvPM combustor and enable compact, high OPR core to achieve 20% fuel burn
- Develop **Advanced Thermal Management System** and waste heat recovery system
- **Hybrid Electric Embedded Generator**: develop integrated electric-power generation system within the engine

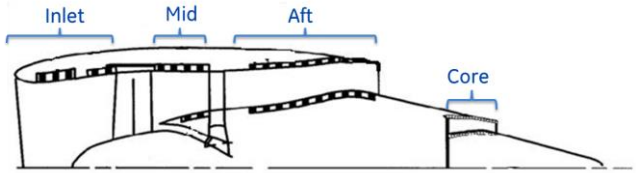
High Level Schedule

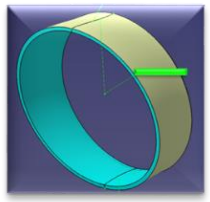
	2021	2022	2023
Design			
Fabrication, Procurement, Assembly			
Technology Demonstration			

*CFM56 and LEAP engines are products of CFM International, a 50-50 joint company between GE and Safran Aircraft Engines.

Advanced Acoustics

Novel Liners





Fan Source Strength Reduction

Anticipated Benefits

- Novel Liner:
  2 EPNdB cumulative noise reduction relative to SDOF w/ neutral performance impact
  or
- Fan Source Strength Reduction Concept:
  1 EPNdB cumulative noise reduction w/ performance neutral impact

Objectives

- Develop Novel Acoustic Liners.
- Develop Fan Source Strength Reduction Concepts

Work Statement

- Execute subscale acoustic test of fan source strength reduction concept hardware developed under CLEEN II
- Down-select most promising technology (novel liner or fan source strength reduction concept as predicted on a production engine platform
- Complete detailed designed of full-scale down-selected technology
- Manufacture full-scale down-selected hardware suitable for testing

High Level Schedule

Advanced Acoustics	CY 2021				CY 2022				CY 2023				CY 2024			
Task	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Full Scale Hardware Design Phase																
Advanced Acoustic Liner Design																
Fan Source Strength Reduction Concept Design																
Downselect Technology																
Downselected Technology Final Design																
Fabrication, Procurement and Assemebly																
Fabricate Part(s) for Down-selected Design																
Technology Demonstration Phase																
Execute subscale fan test of fan source strength																

MESTANG III

Anticipated Benefits

- More Efficient +/- 270Vdc generator with high power density and increased fuel savings
- New cooling method for increased thermal performance
- Self contained oil system

Objectives

Mature a +/- 270Vdc electric generator development as part of an integrated more-electric primary power system

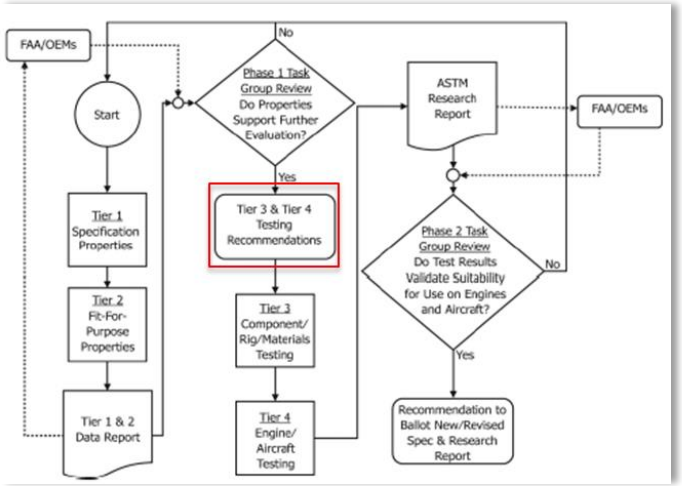
Work Statement

- Design and develop a +/- 270Vdc generator to address current market requirements.
- Improved power generation system design with increased power density at lower cost.

High Level Schedule

- ✓ Program Kick Off – October 1, 2021
- ✓ FAA Consortium – November 2, 2021
- Complete System Requirement Document (SRD) – November 30, 2021
- Preliminary Design Review – February 15, 2022
- Critical Design Review – June 30, 2022
- Complete Procurement of Hardware – September 30, 2022
- Complete Prototype build – January 15, 2023
- Prototype testing with shared Oil – February 28, 2023
- FAA Demo and Final Report – March 31, 2023

Sustainable Aviation Fuel



Designation: D7566 – 20c

Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons[1]

Anticipated Benefits

- Advance the approval of a practical candidate SAF with perceived benefits over nominal drop-in SAF
- Accelerate the standardization and therefore the introduction of 100% SAF

Objectives

- Support qualification of candidate SAF – test/demo
- Advance standardization of 100% SAF

Work Statement:

- Evaluate 100% & 50% (if needed) of CPK-0 SAF for combustor (FAR*) operability/emissions
- Help develop ASTM standard of 100% SAF

High Level Schedule

	2021	2022	2023	2024
Fuel Testing & Demonstration				
FAR Testing				
Development of Fuel Specification for 100% SAF				
Final Report				

*Full Annular Combustor Rig

Building a world that works