Press update – October 3, 2017

Philippe Petitcolin, Chief Executive Officer
Stéphane Cueille, Executive Vice President, R&T and Innovation
AN INTERNATIONAL HIGH-TECH GROUP

2 BUSINESS SECTORS:
Aerospace
Defense

Nearly **58,000 EMPLOYEES** in
almost **30 COUNTRIES**

**15.8 BILLION EUROS** sales*

**2.4 BILLION EUROS** adjusted recurring operating income *

* 2016
Innovation, a major strategic focus at Safran

NEARLY 11% OF SALES INVESTED IN R&D*

21% OF EMPLOYEES INVOLVED IN R&D

1,000 EXPERTS THROUGHOUT THE GROUP

850 PATENTS FILED WORLDWIDE IN 2016

€704 million CAPITAL EXPENDITURES

Safran is one of the TOP 100 MOST INNOVATIVE COMPANIES IN THE WORLD**

*In 2016, Safran had R&D expenditures of more than 1.7 billion euros
**Ranked among Top 100 Global Innovators by Thomson Reuters
2017-2036: aircraft fleet forecasts
Trends by type of aircraft, 36+ passengers, early 2017 – late 2036

■ Solid growth

> Fleet will nearly double in 20 years (Safran forecast)

> **38,900 deliveries** of new aircraft, including 61% single-aisle commercial jets

> Safran’s objective is to offer a disruptive propulsion solution in 15 to 20 years

<table>
<thead>
<tr>
<th>Category</th>
<th>2017-2036</th>
<th>2036</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deliveries of turboprop aircraft</td>
<td>1,680</td>
<td>3,538</td>
<td>x 2.1</td>
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<tr>
<td>Deliveries of regional aircraft</td>
<td>2,979</td>
<td>3,774</td>
<td>x 1.3</td>
</tr>
<tr>
<td>Deliveries of single-aisle commercial jets</td>
<td>13,799</td>
<td>25,720</td>
<td>x 1.9</td>
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<tr>
<td>Deliveries of widebody jets</td>
<td>3,954</td>
<td>8,626</td>
<td>x 2.2</td>
</tr>
</tbody>
</table>

Global fleet at end 2036: **41,658**

Fleet growth between early 2017 and late 2036: **x 1.9**

source: Safran Aircraft Engines
LEAP® - Combining the best technologies from Safran Aircraft Engines and GE

LEAP-1A
Entry into service
August 2016

A320neo

LEAP-1B
Entry into service
May 2017

737 MAX

LEAP-1C

CFM No.1 global supplier of engines for single-aisle commercial jets
13,100+ LEAP engines on order

15% reduction in fuel consumption*

15% reduction in CO₂ emissions*

* In relation to previous-generation engines

Safran / 03 Octobre 2017 / Conférence de presse Open Rotor Istres

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Challenges for tomorrow’s aero-engines: reduce fuel consumption and improve environmental performance

ACARE (Advisory Council for Aviation Research and Innovation in Europe) objectives for 2000-2050:

- 75% decrease in CO₂ emissions
- 90% decrease in NOx emissions
- 65% decrease in noise
- 0 emissions during taxiing
High bypass ratio architectures – Open Rotor and UHBR

- **Objective**
  > Reduce fuel consumption and improve environmental performance

- **Two approaches under consideration**
  > **Open Rotor**: unshrouded engine with a bypass ratio* exceeding 30:1 - installation at rear of fuselage
  > **UHBR (ultra high bypass ratio)**: shrouded engine with a bypass ratio of about 15:1. Similar to current turbofans, with installation under the wing

* Bypass ratio: ratio between cold and hot airflows

**Bypass ratios**

- **CFM56**: 6
- **LEAP**: 11
- **Open Rotor**: 30+
Open Rotor: a European project developed through Clean Sky research program

Milestones

- **2008** - Launch of Open Rotor project within scope of Clean Sky, led by Safran
- **2013** – Tests of counter-rotating fans at ONERA, French aerospace research agency
- **2015** – Assembly of demonstrator starts
- **2016** – Start of Open Rotor ground demonstration tests
- **May 2017** – Installation of engine on open-air test rig and Istres, and start of testing

**65 million euros** in funding from European Commission over a period of eight years, via Clean Sky
Open Rotor: a disruptive engine architecture with unshrouded fans

Engine architecture:

- A turbine driving a pair of unshrouded counter-rotating fans
- A conventional gas generator
- Installed at the rear of the fuselage

FACTS & FIGURES

10 tons of thrust
Bypass ratio over 30:1
2 fans, each 4 meters in diameter
Open Rotor: a technological challenge

Objectives:

- Develop technology building blocks
- Show that they can be integrated on aircraft
- Meet the environmental challenge (chiffres clés: Up to 15% lower fuel consumption than LEAP / Chapter 14: Acoustic performance on a par with LEAP, proven in wind-tunnel testing)
UHBR (ultra high bypass ratio): a medium-term solution for aircraft manufacturers

■ **Objective**: entry into service as from 2025

■ **Development of key technologies** (reduction gear, high-speed turbine) via UHPE (ultra high propulsive efficiency) demonstrator in Clean Sky 2

■ **Same ability as current engines to be mounted under wing** (chiffre: 5 to 10% lower fuel consumption than LEAP)

**FACTS & FIGURES**

5 to 10% lower fuel consumption than LEAP
Safran: a pivotal role in new aircraft designs

- Working closely with airframers to develop innovative aircraft architectures

Unshrouded engines like the Open Rotor

Semi-integrated engines

Distributed propulsion
Safran: a pivotal role in new aircraft designs

- New energy architectures
  - Non-propulsive energy
  - Hybrid/electric propulsion

- More autonomous aircraft and civilian drones
Combining electric taxiing and fuel cell to deliver high environmental value-added

- An electric taxiing system, powered by electricity from the APU, allows an aircraft to taxi without needing its jet engines.
- The fuel cell generates electricity from oxygen and hydrogen. It’s a totally “green” energy source that provides electricity for aircraft ground operations and will also support new onboard services.

Safran’s e-taxi system, with power from a fuel cell, reduces emissions by 80% and significantly reduces noise on the ground (schéma: -80% NOx / -60% electric taxiing / -20% fuel cell... idem CO2)

On an Airbus A320 making 2,000 flights/year, the use of this technology would be the equivalent of eliminating emissions from over 1,200 cars and planting over 1,300 trees. (Schéma: Electric taxiing: Reduced NOx/CO2/Fuel cell)
Towards more autonomous planes and new applications

- **Safran: a pivotal role in the development of civilian drones**
  - **European leader** in long-endurance surveillance drones
    - Patroller, first certified European drone of this type
  - **Mastery of critical technologies**
    - Avionics, optronics, datalinks, image processing, sense & avoid
  - **Greater flight autonomy**
    - Integration of drones in civil air traffic
    - Advent of new services
Building foundations for the future of commercial aviation – Safran’s road map

Greater flight autonomy

New energy architectures
- Non-propulsive energy
- Hybrid propulsion

Open Rotor demonstrator
Start of ground tests

UHBR
Ultra high bypass ratio turbofan

New aircraft configurations
New propulsion concepts under study
Istres, the only test center of its kind in Europe

A test rig designed for engines from Safran

> LEAP, Open Rotor and UHBR technology demonstrators, complex architectures and large engines

(chiffres: m²/80,000 sq meters / 18m pylon, 4m in diameter at base / 660 sq meter control building + 45 operators / Data acquisition system with 1,200 measurement channels)

FACTS & FIGURES

- 80,000 sq meters
- 18m pylon, 4m in diameter at base
- 660 sq meter control building + 45 operators
- Data acquisition system with 1,200 measurement channels
Dynamic regional support

- Public authorities
  - French government, Provence-Alps Côte d’Azur region, Bouches-du-Rhône departmental council, and all local partners (Ouest Provence, Provence Promotion, City of Istres, French AF Base 125 and DGA (MoD) flight test center)

- Safran test facilities and partnerships with local companies

- A core project for the future and job generator
  - 90 employees (45 in 2013)
  - Agreement between Safran and Aix-Marseille-Polyaéro university to integrate young people in aviation industry jobs
POWERED BY TRUST