EASA
European Aviation Safety Agency

# Product Certification and Design Organisation Approval Workshop

22nd – 23rd November 2017

Your safety is our mission.

An agency of the European Union

# Aviation goes Electric:
# The EASA Electric & Hybrid Aviation Project

Manfred Reichel
Section Manager, CT.2.2 CS-23 Aeroplanes
Project Manager EASA E&HAP Small Aircraft
Certification Directorate

Your safety is our mission.

An agency of the European Union

# The Scene

- Due to the nature of aviation, the high level of public attention aviation gets, and the complexity of the worldwide network in the back, aviation is internationally well regulated, defined and organised with only limited flexibility.

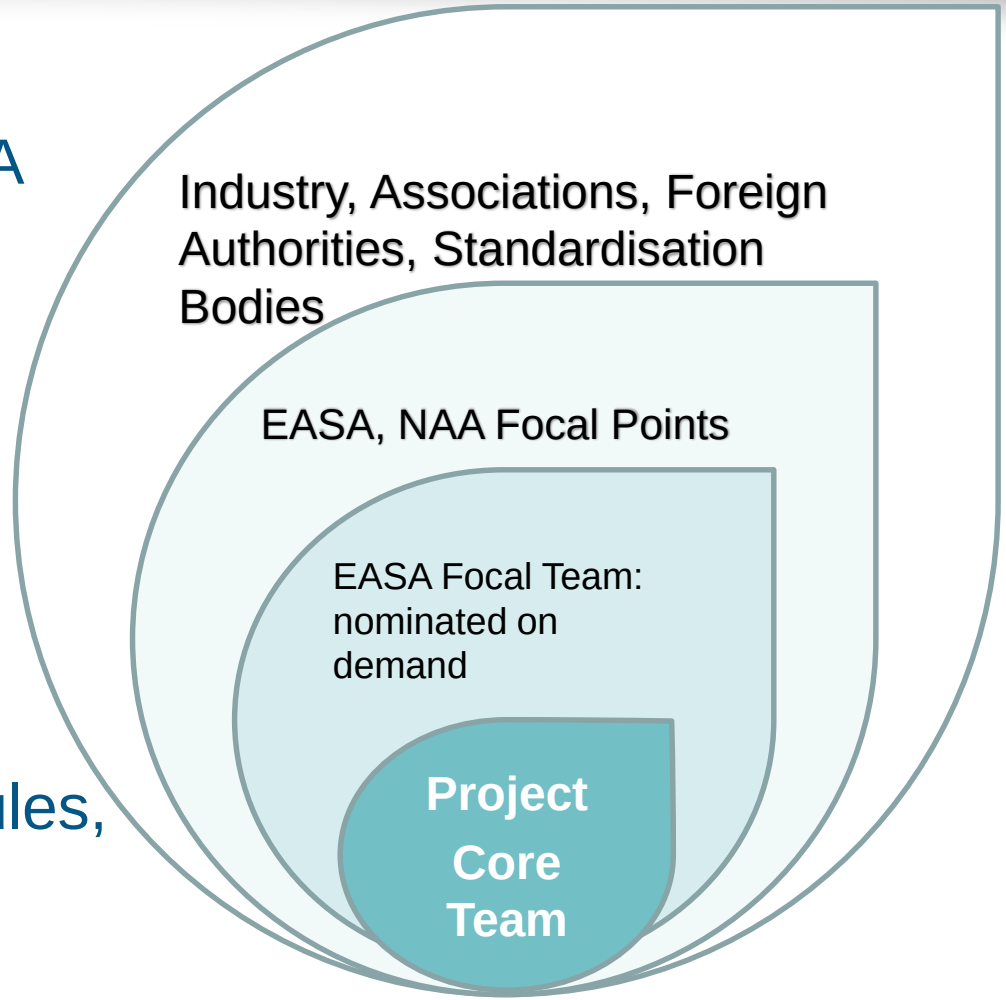
- The future possibilities with the upcoming new technology of electric aviation go far beyond what has been imagined few years ago. They present an important potential for the development of civil applications in a wide variety of aviation sectors and applications

# EASA Electric & Hybrid Aviation Project E&HAP

- To allow EASA and aviation to prepare for the future with electric aviation the Electric & Hybrid Aviation Project (E&HAP) has been launched
- ED Decision NO 2017/134/ED has been published, establishing the E&HAP
- This Project is a transversal project all-over EASA and including NAAs and industry
- The main objectives of E&HAP
  - Coordinate all EASA activities related to E&HAP across directorates (CT, FS, SM)
  - Support
    - development and standardized implementation of SC, ELOS, GM and AMC;
    - research activities, Safety Promotion and IISC (Working Groups and Standards Bodies)
    - industry (guidance, early discussions, ..)
  - EASA interaction with other EU bodies, Member States, and foreign authorities on E&HA.

# EASA Electric & Hybrid Aviation Project E&HAP

- E&HAP Set-Up
  - Transversal range over all Directorates of EASA
  - Internal and external interfaces
  - Small and Large Aircraft Project Managers
  - Manfred Reichel & Carla Iorio
- Make use of
  - Flexibility by Special Conditions & Derogations
  - New performance based, non-prescriptive regulations (CS-23 incl. CS-VLA), new drone rules, etc …)



EASA
European Aviation Safety Agency

# Electric & Hybrid Aviation Project

# → Electric Propulsion

Laurent GRUZ
Head of Propusion Parts & Appliances Department
16/11/2017

Your safety is our mission.

An agency of the European Union

# Agenda

- E-motor: does it fit into current regulations?
- Products already certified by EASA
- Existing EASA rules
- EASA current involvement
- E-motor safer than combustion engines?
- The future

# E-motor: does it fit into current regulations?

- Since the 1930s:

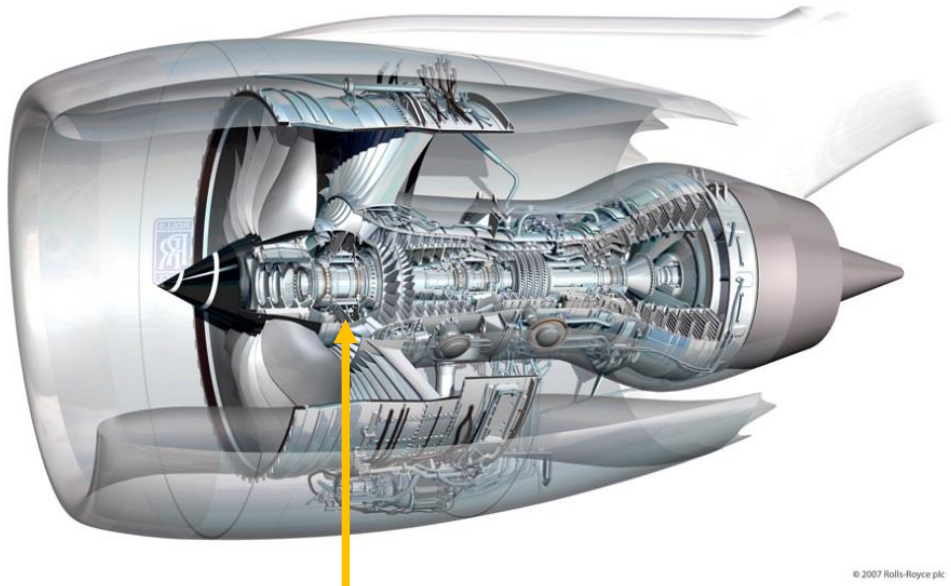
Energy (fossil fuel) is stored in the aircraft (CS 23/25/27/29).

It is turned into thrust / power in a combustion engine (CS-E/CS-APU).

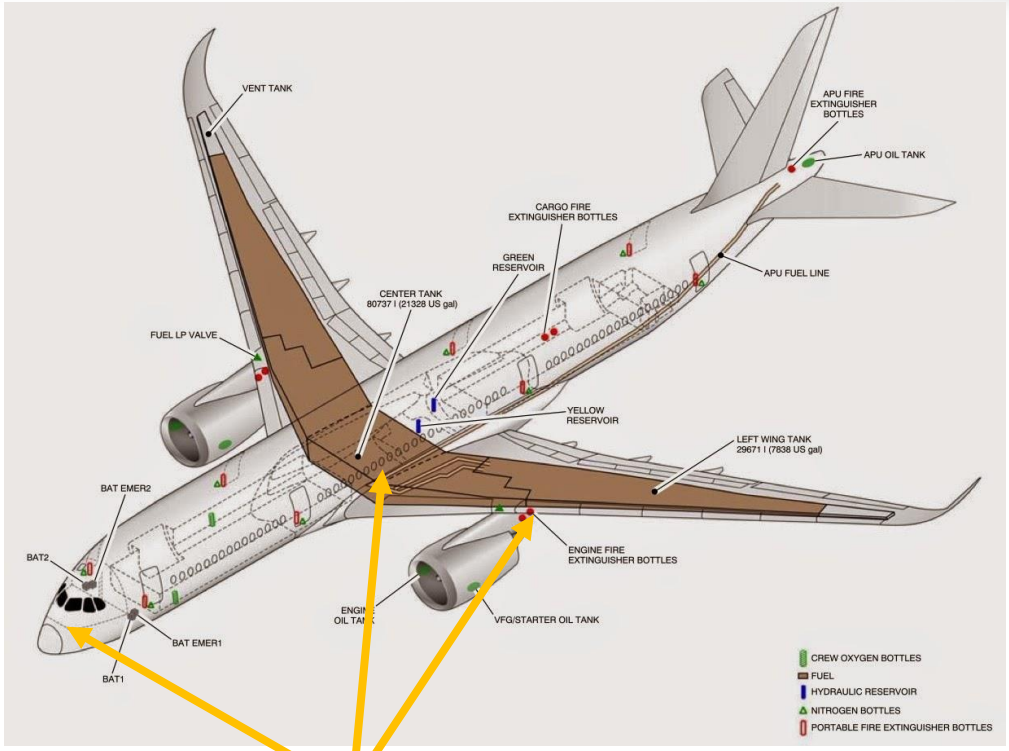
- Tomorrow: ????

# E-motor: does it fit into current regulations?

- Today




Engine
CS-E



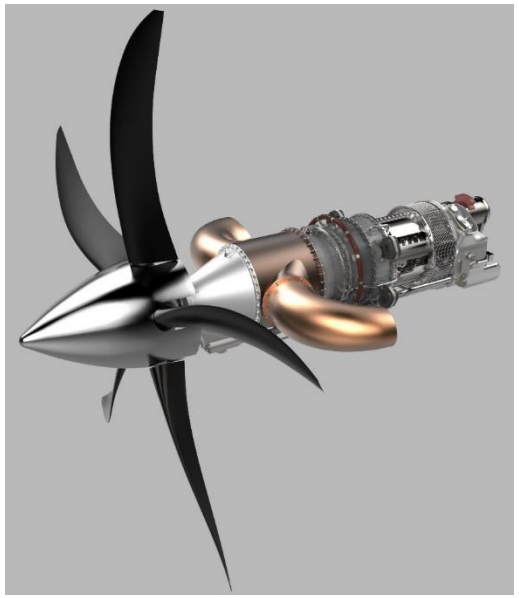

Powerplant (nacelle, fuel tank, fire extinguishing system, avionic, flight controls, electric system…)

CS-23, 25, 27, 29

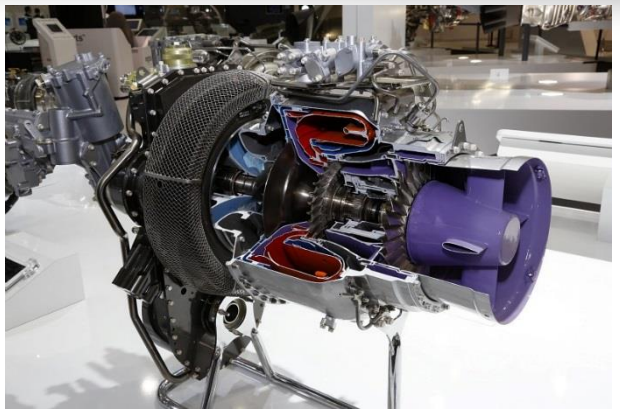
# E-motor: does it fit into current regulations?

- Combustion engines

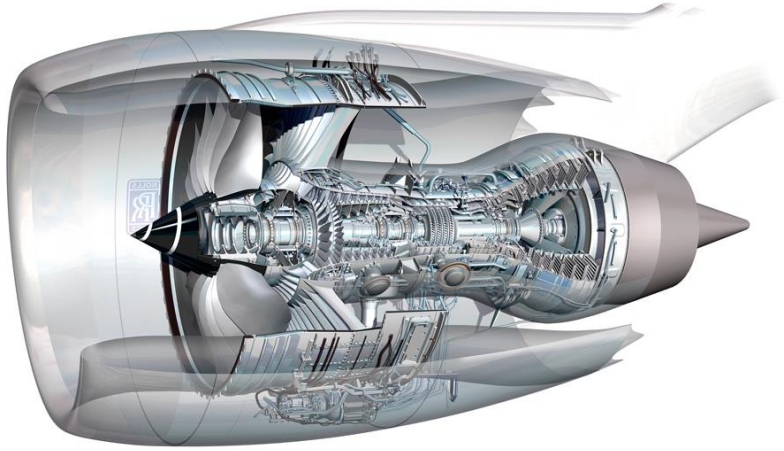
Reciprocating engines



Turboprops



Turboshafts

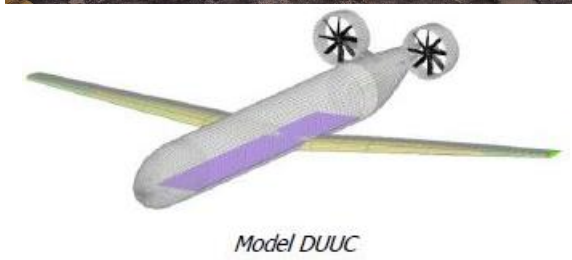


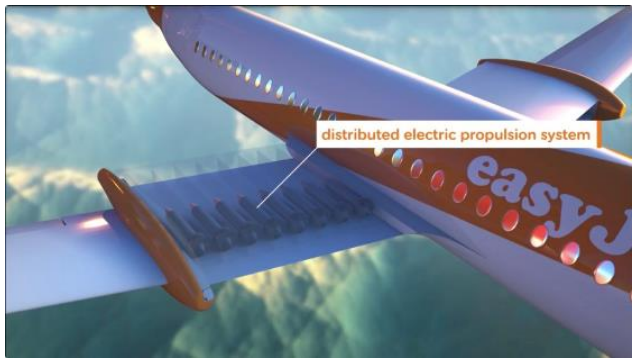
Turbofans

CS-E covers many different engines
(associated with propellers certified under CS-P)

# E-motor: does it fit into current regulations?

- E-world

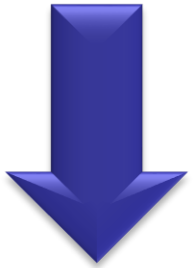




- Electric motors driving a ducted fan ~ « turbofan » perimeter
- Electric motor driving propeller ~ « recip engine driving a propeller » perimeter
- «Distributed» propulsion (1 engine is «coupled» to at least another one)
- Engines ensuring flight stability and control functions

⇨ New perimeters

# E-motor: does it fit into current regulations?

- Are the new technologies covered by current CS rules? **Partially**
- Do these new perimeters fit into current regulations? **No**



Certifying authorities have to adapt and adopt new/modified rules in order to better match with these new products

# Existing EASA rules

- Existing EASA “rules”
  - CRI E-101 - Installation of Electric Propulsion in sailplanes
  - CRI H-101 - Electrical Engine for powered sailplanes

# EASA current involvement

- **STANDARDS for “small” e-motor**
  - ASTM F39 - WK47374 - Design and Manufacture of Electric Propulsion Units for General Aviation Aircraft *- currently not addressing “ducted fan + e-motor” configuration*
    - *Start from Part 33 (FAA rule equivalent to CS-E)*
    - *Removal of requirements non related to E-motor*
    - *Adding of dedicated requirements for E-motor*
  - ASTM F44 - WK41136 - Standard Specification for Integration of Electric and Hybrid-Electric Propulsion Units for General Aviation Aircraft (Airplanes)
- **Several on-going project certifications**
  - Special conditions or CRIs

# E-motor safer than combustion engine?

- ✓ CS-E: engine failures are generally considered ‘minor’.
- ✓ CS-E safety objectives might not fulfil market expectations.

**This should be carefully considered when setting safety objective for E-propulsion**

# E-motor safer than combustion engine?

- **Design and integration**
  - E-motor have a more simple mechanical design: **Safety ↑**
  - E-motor integration allows distributed propulsion: **Safety ↕ Reliability**

Engine failure MINOR

Engine failure MAJOR

**E-motors seem safe**

# E-motor safer than combustion engine?

- **Design and integration**
  - Ex. of post-crash risks minimization for VTOL operations


Fuel tank crashworthiness demonstrated

CS 27 (or 29).952 Fuel system crash resistance

(1) The drop height must be at least 15.2 m (50 ft)

Battery pack crashworthiness?

**E-motor have to be looked when “integrated”**

# E-motor safer than combustion engine?

- **In-service experience**
  - Combustion engines have proven in-flight experience (more than $1.4x10^9$ FH - Boeing data for jet airplanes): **Safety ↑ Reliability ↑**
  - Combustion engine manufacturers have a proven expertise and experience in developing and manufacturing: **Safety ↑ Reliability ↑**
  - Current regulations take into account past 50 years of REX (incidents, accidents)

↓

Combustion engines are safe

# E-motor safer than combustion engine?

- Both engine types can lead to the same Hazards at A/C level
- E-motor design is simple and their integration allows to maximize the safety
- Their integration has to be looked closely
- E-motor have a proven “on-ground” experience
- Combustion engines have a proven “in-flight” experience
- Current rules based on 50 years of Continued Airworthiness

**E-motor look promising » young technology for aviation**

# The future

- Finalize the WK47374: ASTM standard for E-motor dedicated to general aviation
- Developing rules for hybrid engines
- Developing rules for other E-motors (ducted-fan, dedicated to CS-25, 27, 29)

# The future (cont'd)

- 'One size fits all' unlikely:
  - Depending upon technologies,
  - Depending upon industrial organisations.
- EASA open to adapt, willing to support projects, options available:
  - TC for the aircraft,
  - Encompassing all propulsion system
  - TC/ETSO for the engine and/or energy storage.
  - Etc.

# The future (cont'd)

- No pre-conceived DOA/CVE scheme, however all propulsion areas have to be covered:
  - Propulsion
  - Powerplant (propulsion integration),
  - Energy storage ('fuel tank safety')
  - …..

# What we expect from you

- Early coordination with EASA
- Early coordination with NAA
- Clarity and openness
- Support of Standardisation Bodies and active role in development of specifications and rules

EASA
European Aviation Safety Agency

# Thank you for your attention

Your safety is our mission.

An agency of the European Union