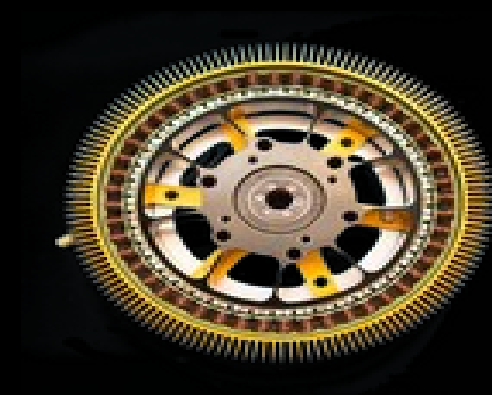




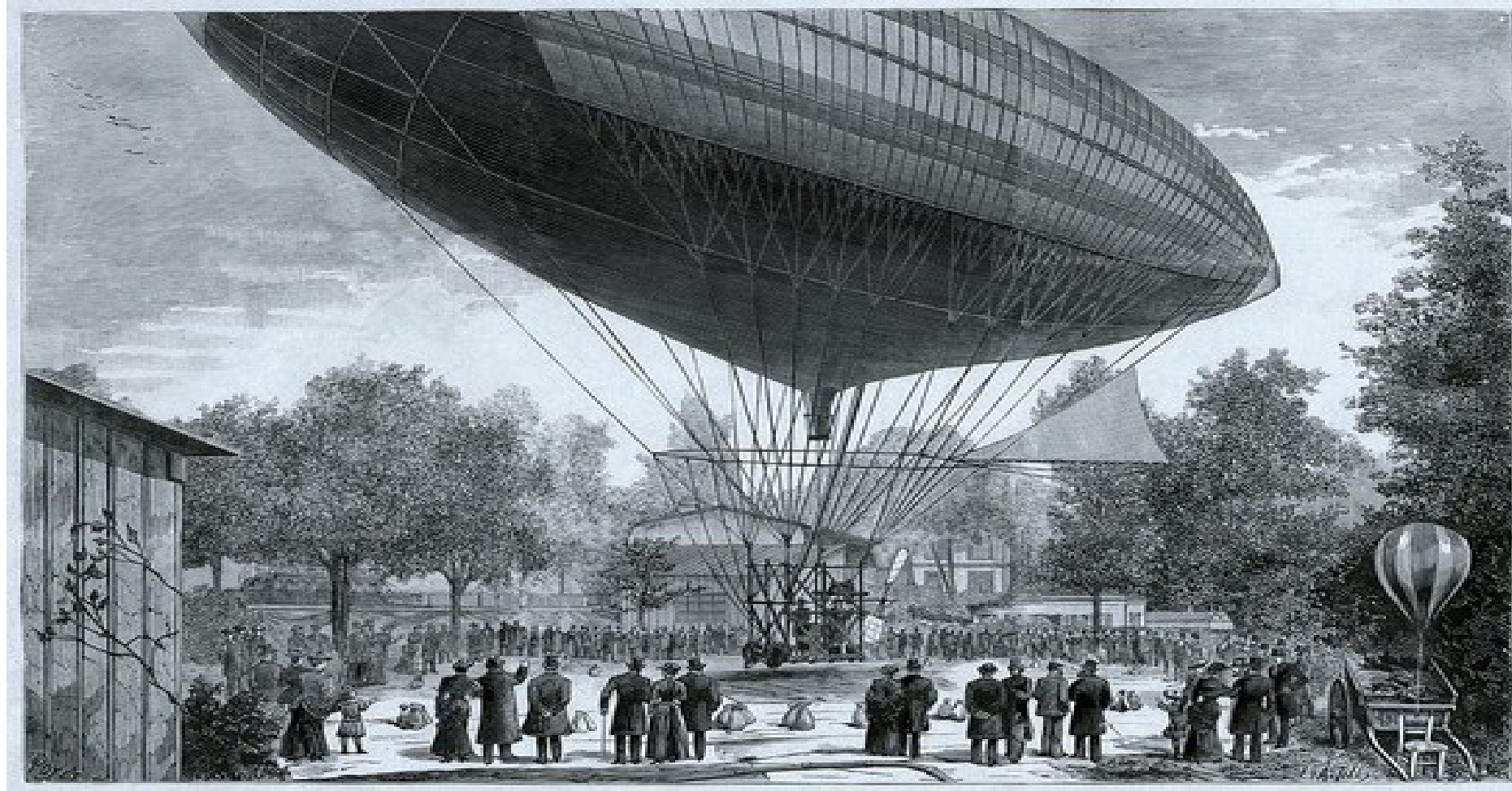
Development of Global Aviation Standards for **Electric Propulsion**



Tom Peghiny, Flight Design – LAMA - ASTM Presenting For Tom Gunnarson, Zee Aero
Electric & Hybrid Aerospace Technology Symposium
9 November 2017

History

In 1883, Gaston Tissandier fits a Siemens electric motor to an airship



The first practical Electric aircraft



The solar powered Sunseeker I was designed in 1989 by Eric Raymond. It was flown across the USA in 1990 also using NiCad batteries.

The MB-E1 was developed from a motorglider by Militky and Brditschka. It flew for 12 minutes in Oct. 1973 on NiCad batteries.



The first certified electric aircraft

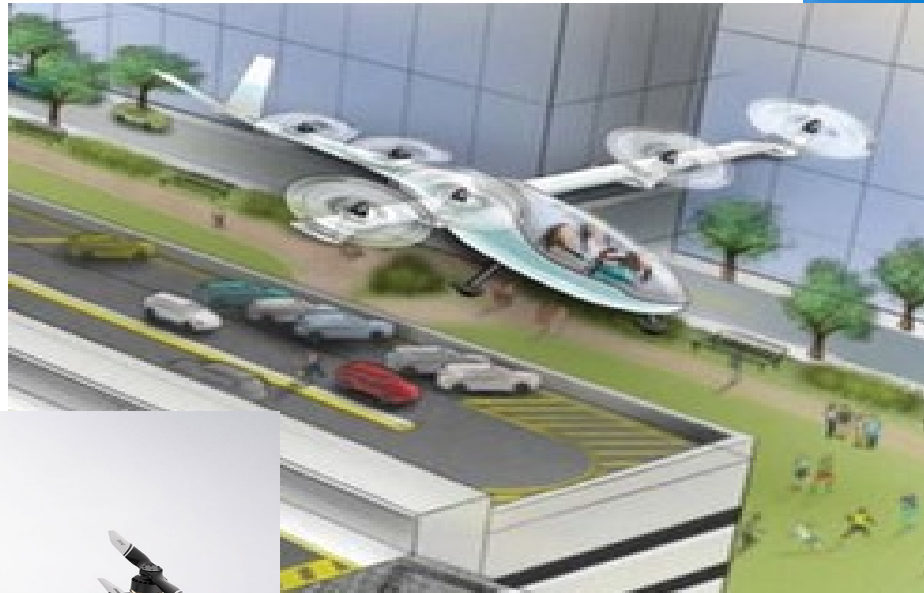
Lange E1 Antares Type
Certificate issued July
2006

Certification Basis includes two
Special Conditions for electric
power system



Power to Transform Aviation

- Quiet
- Clean



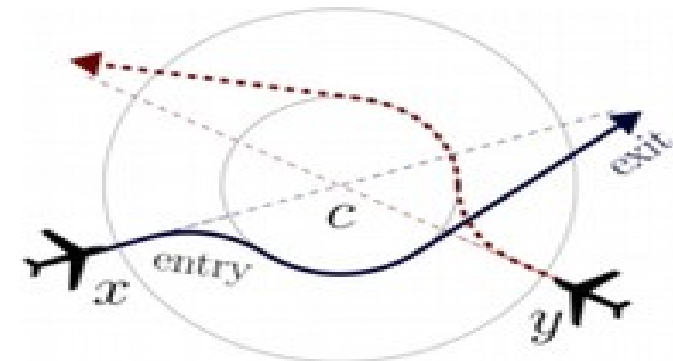
- Economical
- Accessible

Power to Transform the Future

- Performance
 - *Distributed propulsion*
- Integration
 - "Self-aware" aircraft
- Communication
 - *Human Interface*



Leading to FAA interest...



Regulator Interest

FAA Internal Study May 2012

- Historical review
- Technology survey
- Gap analysis

"While still in the early stages, electric aircraft could become viable for use by the general public within the next five to ten years."

Electric
Propulsion



DRAFT

A Regulatory Feasibility Study
May 31, 2012

Technology survey showed

- Little to no vibration or noise except for propeller noise
- No emission of exhaust gases, fuel leakage, or noxious fumes in the cabin
- Inherent Safety Benefit
 - Less susceptible to failure with only one moving part
 - Significantly higher TBO (x10??)

Showed a Regulatory gap

- Current airworthiness requirements do not cover electric propulsion
- Flight training and maintenance requirements must be change and could be reduced due to simpler systems
- Different-use cases blur the aircraft and pilot category lines (OPV, Autonomous, piloted)

FAA - TC Projects & Challenges

- At least three electric TC projects underway
 - Ranging from 10 lb. to 6,000 lb.
 - Manned and Unmanned
- TC process (Part 33, 35, etc.) needs to be determined. Certify the EPU as part of the aircraft Type Certificate under 21.17(b) Special Class. This allows Special Classes of Aircraft where no current standards are available to propose an alternate means of compliance...



EASA Electric Aviation Projects

- At least 5 projects underway
 - Ranging from 200 kg to 5,700 kg
 - Manned and Unmanned
- Certification process using Special Conditions in addition to the existing specifications (CS-E, CS-22)



Operational eFlight aircraft

- Pipistrelle Alpha Electro
- Liaoning RX1E



Regulatory Framework

- Electric propulsion certification under FAR Part 33/EASA CS-E/CS-22
- Needs an overhaul like Part 23/CS-23
 - Means of Compliance are being developed!
 - EPU Design under ASTM F39.05 (WK47374)
 - Propulsion energy storage systems (ESS) under ASTM F39.05 (WK56255)
 - Integration under ASTM F44.40 (WK41136)



ASTM International

- International standards holding organization (like SAE and TUV), meetings held worldwide and many through teleconferences which allows international participation
- Policy developed through “Consensus Standards” balloting process, open, transparent, collaborative, fair-to-all
- All “stakeholders” (Public, Industry, Academia, Governments) represented equally by the ASTM process
- Produces “Living Documents” that can be rapidly adapted for changing technology and field experience
- ASTM used for development of LSA and MOC for new FAR part 23 and CS-23 for worldwide use.



Means of Compliance standards

- **EPU Design under ASTM F39.05 (WK47374)** This specification minimum requirements for the design and manufacture of Electric Propulsion Units (EPUs) for General Aviation Aircraft (Aeroplanes). It covers, motors, controllers, connections, wiring, monitoring and human interface (if required).
- **Electric propulsion energy Storage Systems (ESS) under ASTM F39.05 (WK56255)**
This specification covers the minimum requirements for Electric propulsion Energy Storage Devices (Batteries, Fuel Cells)
- **Integration under ASTM F44.40 (WK41136)** This specification covers minimum requirements for the integration of Electric Propulsion units (EPUs) and Hybrid-Electric Propulsion Units (HEPUs). The work of this task group is to make certain that standards developed will work successfully with other task groups.



ASTM F39.05 - EPU Design

- As a Means of Compliance for FAR 33/CS-E
- Basic designs first:
 - Motors, controllers, safety disconnects, wiring, monitoring and human interface system.
- 54 Stakeholders – FAA, EASA, NASA, CAAC, and industry
- Weekly telecons, 38 drafts so far...
- Will Support Current Applicants
- End Goal – Rewrite of FAR33/CS-E to include electric systems



Work to be Done

- Finish the three major Means of Compliance (MOC) standards .
- Join ASTM International to participate in the creation of these standards, especially public interest groups (non-manufacturers)
- Collaborate on infrastructure to support eFlight
- Work closely with your CAA to make certain they are aware of this great work being done and seek to harmonize these standards worldwide!

Thank you!

