AQUIFER

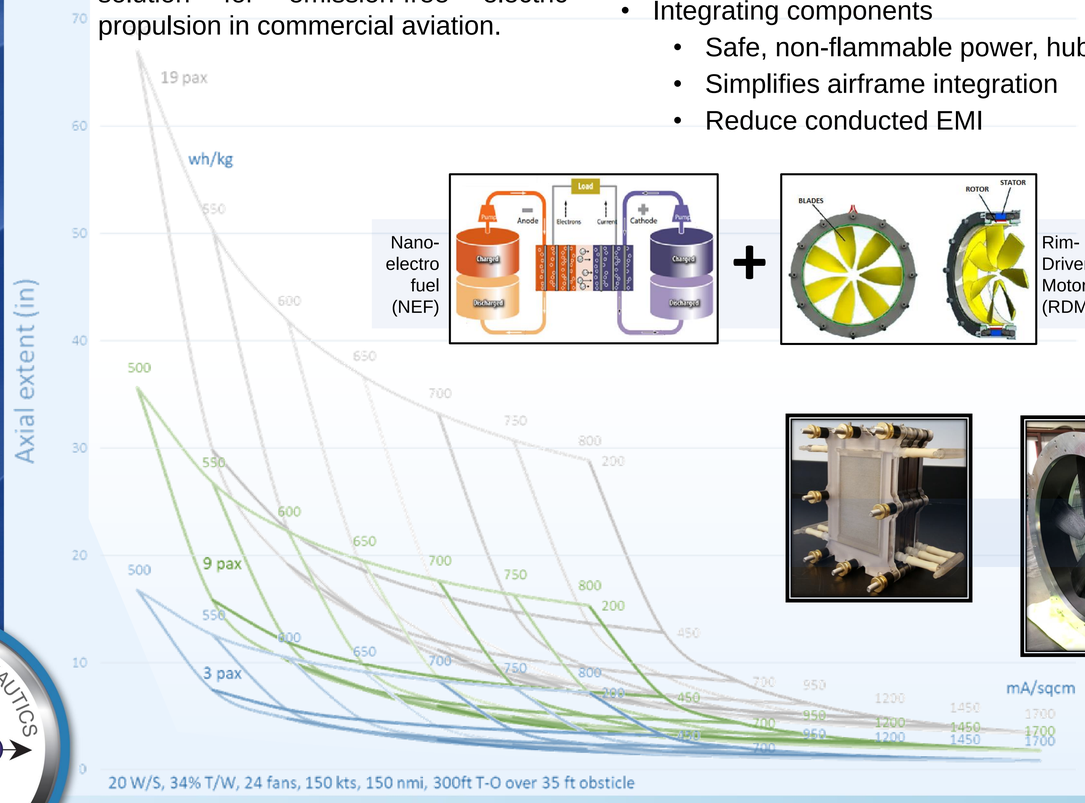
Aqueous, QUick-Charging Battery Integration For Electric Flight Research

National Aeronautics and Space Administration

Integration of Nano-Electrofuel (NEF) Flow-Cell Batteries with Rim-Driven Motors (RDM) for Improved Safety, Noise, Charging Time, and Range of Aircraft Electric Propulsion

Overview / Description

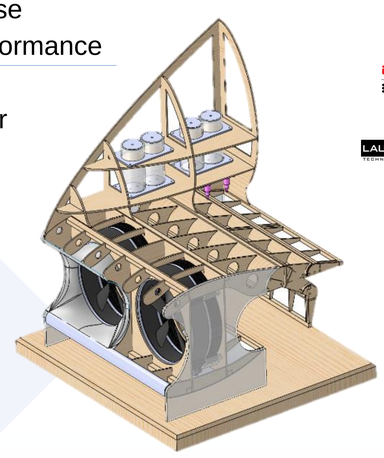
AQUIFER establishes technical feasibility of an early-stage technology, a high-energy density, aqueous-based, flow battery, resulting in a near-term increase of 1.7 times range over an all-electric battery, while retiring fire and explosion hazards associated with lithium-based chemistries. The Nano-electrofuel (NEF) flow battery will be integrated with a rim-driven motor (RDM) as a multi-functional design to eliminate conductive EMI and weight from long cable runs, and provide liquid cooling from the aqueous fuel. When successful, the technology provides an improved safety energy storage solution for emission-free electric propulsion in commercial aviation.



Feasibility Assessment

The feasibility of this project is to demonstrate integration of the NEF battery with each RDM.

- NEF battery development:
  - Gen 1 Chemistry – 100 mA/cm^2 with pack-level specific energy of 125 Wh/kg and 350 Wh/L (for a 4-pax X-57 reference size)
  - Gen 2 Chemistry (cost-sharing dependent) – 200 mA/cm^2 with a pack-level specific energy of 530 Wh/kg (for a 4-pax X-57 reference size)
  - Resulting in a system that is:
    - Thermal runaway safe
    - Emissions free – vehicle
    - Capable of rapid recharging
    - Arcing free
    - and reduces cabling and cooling systems requirements
- RDM development results in:
  - Reduced losses (performance) & noise
  - Increased efficiency and thermal performance
- Integrating components
  - Safe, non-flammable power, hub rotor
  - Simplifies airframe integration
  - Reduce conducted EMI



Partners

- Armstrong Flight Research Center (AFRC) – *PI; Integration Center; test stand development & instrumentation; determining feasibility of system*
- Glenn Research Center (GRC) – *Co-PI; RDM system analysis, controller development & design development support; NEF battery development support*
- Langley Research Center (LaRC) – *Aircraft studies, System ConOps and market fit; acoustic estimation for blades and motor bearings*
- Boeing – *SSTOL / VTOL vehicle concepts; system consulting & analysis; potential cost-sharing partnership*
- ESAero – *Prime contractor; NEF / motor integration, design, testing & demonstration*
- Influit Energy – *NEF battery development*
- Launchpoint Technologies – *RDM design & development*
- Electrocore – *Project support; battery industry research*

Recent Results / Status

- Held Kick-off meeting on 8/6-8/7
- Established weekly technical telecoms for 4 IPTs
- Initiated an aircraft study for different electric propulsion powered aircraft
- Initiated two independent rim-driven motor trade studies and preliminary design considerations

Next Steps

- Complete contract mechanism for NEF battery and motor companies
- Initiate designs for NEF battery and RDM
- Coordinate battery meeting at developer
- Conduct Mission Concept Review (MCR) on 10/16-10/17

CONVERGENT AERONAUTICS SOLUTIONS

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