NASA SBIR 2015 Phase I Solicitation

A1.03 Low Emissions Propulsion and Power

Lead Center: GRC

Participating Center(s): AFRC, ARC, LaRC

Proposals are sought which support electric propulsion of transport aircraft, including turboelectric propulsion (turbine prime mover with electric distribution of power to propulsors) and various hybrid electric concepts, such as gas turbine engine and battery combinations.

Turboelectric propulsion for transport aircraft applications will require components with high specific power (hp/lb or kW/kg) and high efficiency, and cryogenic and superconducting components will likely be required. The cryogenic components of interest include fully superconducting generators and motors (i.e., superconducting stators as well as rotors), cryogenic inverters and active rectifiers, and cryocoolers. Proposals related to the superconducting machines may include aspects of the machines themselves and their subcomponents, as well as low AC loss superconducting materials for the stator windings. Generators with at least 10 MW capacity and motors of 2 to 4 MW capacity are of interest. Technology is sought that can contribute to superconducting machines with specific power more than 10 hp/lb.

Hybrid propulsion with non-cryogenic components will likely require new materials and configurations to reach required high specific power and efficiency. Hence ideas are sought for achieving 2-3X increase in specific power at high efficiency for non-cryogenic motors through a multidisciplinary approach utilizing advanced motor designs, better materials, and new structural concepts.

New approaches to achieving conductors with lower electrical resistivity than copper are particularly sought, e.g., conductors based on carbon nanotubes. However, such approaches must be backed by plausible reasons why a resistivity lower than that of copper can be expected to be achieved, in contrast to the best reported resistivity values for carbon nanotube fibers, which are nearly an order of magnitude higher.

Ideas are also sought to address challenges related to high voltage power transmission in future hybrid electric aircraft.

New modeling and simulation tools for hybrid electric aircraft propulsion systems are also of interest.

Some studies of turboelectric distributed propulsion components and systems can be found in the following and referenced therein:Â

- â€œStability, Transient Response, Control, and Safety of a High-Power Electric Grid for Turboelectric Propulsion of Aircraftâ€, Michael Armstrong, Christine Ross, Danny Phillips, and Mark Blackwelder, NASA/CRâ€”2013-217865, 2013
- â€œTurboelectric Distributed Propulsion in a Hybrid Wing Body Aircraftâ€, J.

Felder, G. Brown, H. Kim, J. Chu, 20th ISABE Conference, GÃ¶tenberg, Sweden, 12-16 Sept., 2011

- â€œWeights and Efficiencies of Electric Components of a Turboelectric Aircraft Propulsion Systemâ€, G. V. Brown, 49th AIAA Aerospace Sciences Meeting, Orlando FL, January 4-7, 2011
- â€œTurboelectric Distributed Propulsion Engine Cycle Analysis for Hybrid-Wing-Body Aircraftâ€, J. L. Felder, H. D. Kim, G. V. Brown, 47th AIAA Aerospace Sciences Meeting, Orlando FL, January 5-8, 2009