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M4Or1A-05 [Invited]: Development of Superconducting-Magnetic-Energy-Storage (SMES) for Electric Aircraft Propulsion

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Electrical energy storage devices are critical components of electric power systems of every aerospace vehicle. They are needed for many functions, such as an energy source for electric-vehicle (EV) propulsion, as an electrical accumulator unit (EAU) to handle 2-3x higher-than-average transient loads both on/off the power buses, for emergency power during system failure, and to provide high-power for pulsed loads. Superconducting-magnetic-energy-storage (SMES) devices offer unique features for aerospace applications including the highest power densities of any technology > 100 kW/kg for both charge and discharge, 100% storage efficiencies for unlimited times, and virtually no degradation for up to 10^8 charge/discharge cycles for some designs. This paper will describe about the research and development of SMES for electric aircraft propulsion, and provide a recent update on the performance of SMES and large magnets being built. The development of supporting technologies needed to integrate SMES into aerospace vehicles will be presented. In-house computation of the design of SMES devices optimized for mass-specific energy densities will be shown, and compared with devices presently existing or being developed. The energy density of SMES was traditionally < 10 Wh/kg, however recent computational investigations indicate the energy densities could reach > 100 Wh/kg and be competitive with Li-batteries.

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