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M3Or4A-02: [Invited] A Double Rotor Flux Switching Machine with HTS Field Coils for All Electric Aircraft Applications

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The increasing demand for high-power density motors in electric transport industries opens a new research opportunity to develop motor topologies with less weight and high efficiency. In particular, all-electric aircraft applications require very high-power density motors. This study designed a new 1 MW 20pole/15slot double rotor Flux Switching Machine with high-temperature superconducting field coils (DRFSM-HTS). The construction of the motor constitutes an air core stator that carries both the normal state conductors and REBCO superconducting tapes. Aluminum Litz Wire (ALW) is used as armature conductors, and the Yttrium Barium Copper Oxide (YBCO) high-temperature superconducting material is used as field coils. The motor was designed to operate at either 65K cooled with a secondary loop of subcooled liquid N₂, or 20K with liquid hydrogen cooling. The machine operates under cryogenic temperatures. At 20K the power density obtained with the proposed design is > 100 kW/kg for the active elements and > 29 kW/kg for all components including the thermal-management-system and inverter drive. And at 65K both power density and efficiency decrease slightly. The unique properties and benefits of this motor design for aerospace and transportation applications will be presented.

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