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M3Or3A-02 [Invited]: High Power Density HTS Cables for Electric Transportation Applications

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Second Generation High Temperature Superconducting (2GHTS) power systems are being developed for a variety of applications including the electrical power grid, industrial applications, data centers, high energy physics, electric ships, and electric aircrafts. There are some common requirements and design features for HTS devices for all the applications. However, the design requirements for electric transportation applications such as electric aircrafts and electric ships are more stringent in terms of gravimetric and volumetric power densities. The power density demands require that the HTS generators and motors in electric transportation applications operate at temperature between 20 and 50 K to compensate for the reduction in critical current density and AC losses under the substantial magnetic fields present in the rotating machines. HTS power distribution cables, however, can achieve high enough current densities when operated at higher temperatures of 40 - 60 K. The primary challenge with power cables that carry multiple kA are the cable terminations, current leads, and cryogenic interfaces. Innovative compact designs are needed to address the challenges in the dielectric and cryogenic thermal designs. We at the Center for Advanced Power Systems (CAPS) are collaborating with other academic institutions and several small businesses to address the challenges of cryogenic designs, dielectric insulation, and resiliency of HTS power cables for transportation applications. We have ongoing work on cryogenic dielectrics and cooling systems for HTS applications for electric transportation applications. The Presentation will focus on the ongoing research, recent collaborative accomplishments, and outstanding challenges in these areas.

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