



Contribution ID: 875

Type: **Invited Oral Presentation**

M3Or3A-01 [Invited]: HTS Cable for Power Distribution in Hybrid-Electric Propulsion System for Aircraft

Wednesday 24 July 2019 14:00 (30 minutes)

In the framework of 'Flightpath 2015' the European Union set ambitious goals for the aviation sector. Compared to a typical new aircraft of the year 2000 the goals for reduction of CO₂ and NO_x greenhouse gas emissions were set to 75% and 90% per passenger kilometer, respectively. Aircraft movements during taxiing should be emission-free and the anticipated noise reduction of a flying aircraft was set to 65%. These ambitious goals can only be reached with new propulsion techniques and redesign of aircraft. Electric and hybrid-electric propulsion are seen as enabling technologies to reach the goals of "Flightpath 2050". However, for larger passenger aircraft the required electric power is in the order of several 10 MW. Batteries are far too heavy to deliver the full amount of required energy. Gas-turbines and generators will provide the major part of electricity that is used for thrust generation. A big advantage for aircraft design is the possibility to decentralize power and thrust generation. The cable currents, however, will be in the range of several kilo amps due to the large power combined with low voltages in the aviation sector. Superconductivity is seen as enabling technology for the realization of large hybrid-electric passenger aircraft with propulsion systems consisting of superconducting motors, generators and cables with high power-to-mass ratio.

In the framework of the German TELOS-project KIT is developing a DC HTS cable concept for hydrogen cooled hybrid-electric propulsion systems. Two stacks of REBCO tapes build the core of the two-pole cable. Compensation of Lorentz forces between the two poles, compensation of thermal length changes and sufficient electric insulation are major challenges for the cable design as well as low-resistive joints to connect the single elements of the busbar system. We will present details of the cable and joint design, results of Lorentz-force and high-voltage tests and first test results of the cable demonstrator.

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Session Classification: M3Or3A - Transportation Symposium: Transportation Cables