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Thu-Mo-Or18-02: Development of non-insulated racetrack coils wound with second generation high temperature superconductor tapes for a stator system for wind generators

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With the high current carrying capacity of second generation superconductors the increase of power density of electrical devices is a main research subject in the field of superconductor's application. Several studies show a potential reduction in volume and weight of electrical rotating machines, while keeping the rated power output. Especially, compact and more lightweight generators in offshore wind turbines would result in a reduction of the levelized cost of energy. Whereas most of the superconducting wind generator designs follow the principle of a synchronous machine with a superconducting rotor, this approach investigates the implementation of the superconducting coils on the non-rotating stator, which enables a simplified cryostat and cooling system design. To avoid the use of cryogenic liquids and reach temperatures below 77 K a conduction cooling method for keeping the coils at their operating temperature is envisaged.

Furthermore, the self-protecting ability of coils without a turn to turn insulation could make the need of a complicated and sensible quench protection system redundant. To expedite the use of such coils in a real power application the design and construction of a 10 kW laboratory generator demonstrator is set as an objective. Therefore, a pancake racetrack coil is designed for the usage in the stator system of such a demonstrator and wound without any insulation between the turns. The performance of this coil, especially under conduction cooled conditions below 77 K, is investigated. The first results in terms of effectiveness of the cooling system, recording the typical parameters of non-insulated coils and investigating the thermal and electrical behavior at dynamic load situations is presented.

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