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Thu-Mo-Po4.08-04 [56]: Electromagnetic Design of HTS DC Generator with Iron-cored Stator and Rotor

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Offshore wind energy is going to take the dominated place in renewable energy due to it abundant and steady wind resource. To reduce the levelized cost of energy, the large power rate, even above 10 MW, wind generators are preferred for offshore wind farms. Compared with conventional wind generator such as induction generators and permanent magnet generators, high temperature superconducting (HTS) wind generators are lighter and smaller in size due to the much high magnetic loading produced by HTS coils. Therefore, HTS wind generator becomes a potential candidate for future offshore wind market and attracts attentions of researchers.

An HTS DC generator with ironed stator and rotor is proposed for offshore wind turbine. Unlike the traditional DC generator, the armature windings of proposed generator are equipped in the outer rotor. This structure can obvious improve the line load and torque density. HTS field coils are fixed on the inner stator and modular cryostat structure is considered in this topology. The double iron structure, as well as the modular cryostat, reduces the magnetic reluctance of this machine, which can effectively reduce the cost of HTS material with the same magnetic loading.

This paper designs and analyzes a 10MW HTS DC generator. The electromagnetic performances of proposed HTS DC wind generator are investigated by using the finite element method (FEM). In addition, the feasibility and practical value are evaluated by quantitative comparison with the same scale HTS synchronous wind generator in term of the electromagnetic performance, weight, volume and active material cost. The results show that the proposed HTS DC generator is quite comparable to the HTS synchronous wind generator.

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