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[Invited] Cost Comparison Studies of Different Superconductors for a Direct Drive Wind Generator

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Design studies for a direct drive superconducting generator rated 2 MW 3.3 kV 18 rpm have been performed using various commercially available superconductors for the field coils. The electromagnetic design is performed using two-dimensional transient nonlinear finite element analysis by following three-step modeling approach. In the first step, an open circuit model is analyzed and the appropriate ampere-turns are used for field excitation using YBCO second generation (2G), Bi 2223 and MgB2 superconductors to obtain the required no load stator induced voltage. In the second step, the stator windings are energized with rated load current at an instant time to calculate the rotor position angle for the necessary torque. Finally, a transient simulation is performed for the rated load to calculate the torque using the initial rotor position determined in the second step. Many design iterations have been performed using various geometrical topologies to minimize the cost of superconductors at selected operational field coil temperatures. The paper discusses the design iterations performed and future technical challenges to be resolved for commercial application of the superconducting technology.

Primary author: Dr KARMAKER, Haran (TECO Westinghouse)

Presenter: Dr KARMAKER, Haran (TECO Westinghouse)

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