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[Invited] 15% reduction in AC loss of a 3-phase 1 MVA HTS transformer by exploiting asymmetric conductor critical current

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An asymmetric dependence of the critical current on the direction of an applied magnetic field in HTS coated conductors has a non-trivial influence on the AC loss of coil windings. We report the modelled influence of real conductor critical current asymmetry on the AC loss characteristics of a 1 MVA HTS transformer design previously demonstrated by the Robinson Research Institute as well as a stand-alone coil having the same geometrical and electrical parameters as the low voltage (high current) winding of the transformer. We compare two commercial HTS conductors with distinctive differences in their critical current asymmetry and show a maximum variation of 15% and 29% in the calculated AC loss of the transformer and the stand-alone coil winding, respectively, when the conductor orientation is varied in the top and bottom halves of the windings. AC loss simulation giving consideration to asymmetric conductor critical current before winding the transformer could lead to substantial AC loss reduction even using the same amount of conductor and the same transformer design.

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