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Modelling AC ripples in HTS coated conductors

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DC transmission using high temperature superconducting (HTS) coated conductors offers a promising solution to the globally growing demand for effective, reliable and economic transmission of green energy up to GW level over very long distances. The credible estimation of the losses and thereby the heat dissipation involved is highly essential for the rational design of practical HTS DC transmission cables and corresponding cryogenic systems to fulfill this demand. In this respect, the evaluation of the dissipation caused by AC ripples (introduced in rectification / AC-DC conversion) is needed. Here we report a targeted modelling study into the AC losses in a HTS coated conductor subject to DC currents and AC ripples simultaneously, by solving Maxwell's equations using the finite element method (FEM) in the commercial software package COMSOL. It is observed that the instantaneous loss exhibits only one peak per cycle in a HTS coated conductor subject to sinusoidal ripples and DC currents that are within our targeted conditions. This is a distinct contrast to the usual observation of two peaks per cycle in a HTS coated conductor subject to AC currents only. The unique mechanisms behind are also discussed. Finally, the magnitude of the AC ripple losses and their importance in the design of HTS DC transmission cables are estimated.

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