Contribution ID: **54** Type: **Poster**

3D Modelling and Magnetization Losses in CORC-TSTC hybrid composite conductors

Wednesday, 12 June 2024 10:40 (20 minutes)

The so-called Conductor On Round Core (CORC) and the Twisted Stacked-Tape conductor (TSTC) are both the most compelling candidates for the development of high temperature superconducting (HTS) cables, both with the high current carrying capabilities required for the future development of fusion projects, with the CORC cross-sectional design being generally larger than its TSTC counterpart. In this sense, to solve the spatial inefficiency in the former volume of the CORC conductor and solve the limitation of the conductive current of the TSTC, whilst remaining true to the CORC dimensions, the feasibility to manufacture a CORC-TSTC hybrid cable has been proven by a team of Korea researchers, where their measurements of current density and AC losses are yet to be validated by the scientific community. Thus, in this paper, we perform a comprehensive electromagnetic study validating the experimentally measured AC-losses of a series of CORC-TSTC hybrid cables under external magnetic field, utilizing a three-dimensional simulation environment capable to account for the 3D current dynamics inside the HTS tapes, and not only on a mathematically reduced and virtually homogenised 2D surface where the loops of magnetization currents can be incoherent with the well stablished physics of the Bean's mechanism. The cables will be modelled under the base of a six-tapes single layer CORC cable with the former made of analogous stacked HTS tapes produced by SuNAM Co., Ltd. The study will consider the impact of the increment of stacked layers in the TSTC former, running from one to up to four stacked tapes and, the influence of the acute magneto-angular anisotropy of the GdBCO tapes, which will be brought forward from additional experimental measurements that will ensure a proper benchmark for the validation of the experimentally measured AC-losses in these hybrid cables.

Topic

Innovative methods and tools for modelling large-scale HTS systems

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Session Classification: Poster Session