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M1Po2C-11 [44]: AC Loss Analysis on Coated Conductors at different sinusoidal frequencies for Electric Propulsion Applications

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Superconducting magnets are one of the superior contenders in achieving the targets of electric aircraft industry successfully as they have very high power densities compared to other battery storage systems. Many aviation research agencies are looking at superconducting magnets as one of the alternate in replacing the conventional jet engines completely (electric aircrafts) or partially (hybrid aircrafts). National Aeronautics and Space Administration (NASA) and Air Force Research Laboratory (AFRL), USA has reported that high temperature superconducting magnets possesses higher specific energies (Wh/kg) and have infinite number of recharge cycles compared to other storage technologies employed for energy requirements. The other advantage of using such magnets is that there will be no hazardous disposals like batteries which lower the overall pollution. Superconducting magnets are DC operated systems however during charging or discharging transient behaviour of current results in the losses which would further ends up with heat generation. Heat generation during charging or discharging period would cause quenching of the superconductor due to sudden temperature rise.
In this work, electromagnetic analysis on superconducting magnet having capacity of 1kWh/3.6MJ has been performed where a 2D numerical model is developed using H-formulations in order to estimate the AC losses for a high temperature superconducting tape manufactured by SuperPower (SCS 12050) having 330A critical current at 77K. AC current having a load factor of 60.6% has been fed through the stacked tapes at 50Hz, 60Hz and 70Hz frequency and the magnetic flux along with current density distributions have been analysed and compared. It has been found that at higher frequencies the AC losses are found to be large than lower frequencies. Overcritical currents have been found in the current density distribution due to the application of E-J relationship for the homogeneous 2D numerical model.

Primary authors: KUMAR, Abhinav (Lovely Professional University, Phagwara); Dr LAL JEYAN, JV Muruga (School of Mechanical Engineering); Dr AGRAWAL, Ashish (School of Mechanical Engineering)

Presenter: KUMAR, Abhinav (Lovely Professional University, Phagwara)

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