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Estimation of Losses in the (RE)BCO Two-coil Insert of the NHMFL 32 T All-superconducting Magnet

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(RE)BCO commercial coated superconductors have gained an increasing interest for its use in high magnetic field magnets. The leading project is the 32 T DC user magnet to be commissioned soon at the National High Magnetic Field Laboratory, Florida, USA. This state-of-the-art high field all-superconducting magnet, bath-cooled at 4.2 K, is comprised of a two-coil insert pancake-wound with (RE)BCO tapes supplied by SuperPower Inc. and a multi-coil LTS outsert. To ensure the reliable operation of such a complex magnet, it is important to estimate the hysteresis losses which arise in the insert during ramping operations. Such an estimate will allow implementing safe operational procedures to avoid premature quenching of the magnet and, in the worst case, the failure of the insert. The insert coils are assembled from tens of pancakes and thus have thousands of turns, with notable variations in the critical current throughout the pancakes. Therefore, estimating the losses in such a large and complex superconducting magnet presents a significant challenge that requires an efficient strategy without compromising the accuracy of calculations. We propose here a new approach relying on a multi-scale scheme to achieve a high computational efficiency. This new method is flexible enough to simulate different sections of the entire insert with the right level of detail while providing a larger computational speed than other approaches using the finite element method. Estimates of the hysteresis losses in the 17 T insert for a ramping operation sequence are presented.

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