High-temperature Superconducting Conductor on Round Core Magnet Cables Operated at High Current Ramp Rates in Background Fields of up to 19 T

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Abstract - The next generation fusion magnets are likely to incorporate high-temperature superconductors that are bundled into high-current cables. Conductor on Round Core (CORC) magnet cables, containing many RE-Ba2Cu3O7-d coated conductors wound into multiple layers, are a promising candidates that will ensure a low magnet self-inductance, allowing for high current ramp rates during operation. One concern with CORC cables is that the current distribution between the various layers could become inhomogeneous at ramp rates that exceed 10 kA/s. We've constructed a CORC cable that contained 52 tapes in 17 layers, having a critical current of over 5 kA at 4.2 K in a background field of 19 T, and calculated its inductive matrix. The model predicted a relatively homogeneous current distribution, even at current ramp rates as high as 100 kA/s. We've successfully verified this prediction by measuring the inductive voltage of the CORC cable at current ramp rates as high as 68 kA/s in background fields of up to 19 T. The cable didn't show any sign of early transition up to the critical current, even at high current ramp rates. The results confirm that CORC cables are promising candidates for use in superconducting magnets that operate at high current ramp rates. The model has been used to investigate the electrical performance of a 7 kA cable made from 22 layers. In addition, preliminary estimates of a 10 kA cable with 30 layers will be done. The limitation on the number of layers in a single cable will be discussed. Higher currents will be obtained through the use of multiple CORC's, in a CICC-like cable.

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