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Thu-Af-Or20-05: Quench simulations versus experimental observations on the HL-LHC MCBRD canted-cosine-theta short models and prototype magnets

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In this paper, quench simulations on the High-Luminosity Large Hadron Collider (HL-LHC) MCBRD canted-cosine-theta (CCT) magnets are compared to experimental observations on the MCBRD short models and prototypes. These magnets feature insulated NbTi/Cu strands wound in aluminium formers, where two concentric coils held in place by the formers produce a dipole field over the bore.

The magnet quench protection strategy relies on a combination of energy extraction, current transformation to the conductive formers, and quench-back from eddy current heating in the formers resulting in the onset of a normal zone throughout the magnet. Without considering quench-back and current transformation, the protection of this magnet type solely by means of energy extraction would be very challenging, given that the voltage over a single energy extraction system during the discharge would be in the order of several kilo-volts for these high-inductance magnets. The experimental observations on the MCBRD prototype showed that the transient behaviour of the magnets during the discharge is strongly affected by the presence of super-fluid helium in between the formers, which affects quench-back in a detrimental manner. In this paper the manner in which these complications are treated in the quench simulations is discussed. Finally, the quench protection strategy and its implications for the D2 corrector circuits powering the MCBRD magnets are presented.

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