Quench Behaviour of Prototype HL-LHC Dipole Canted Cos-Theta Orbit Corrector Nb-Ti Magnet

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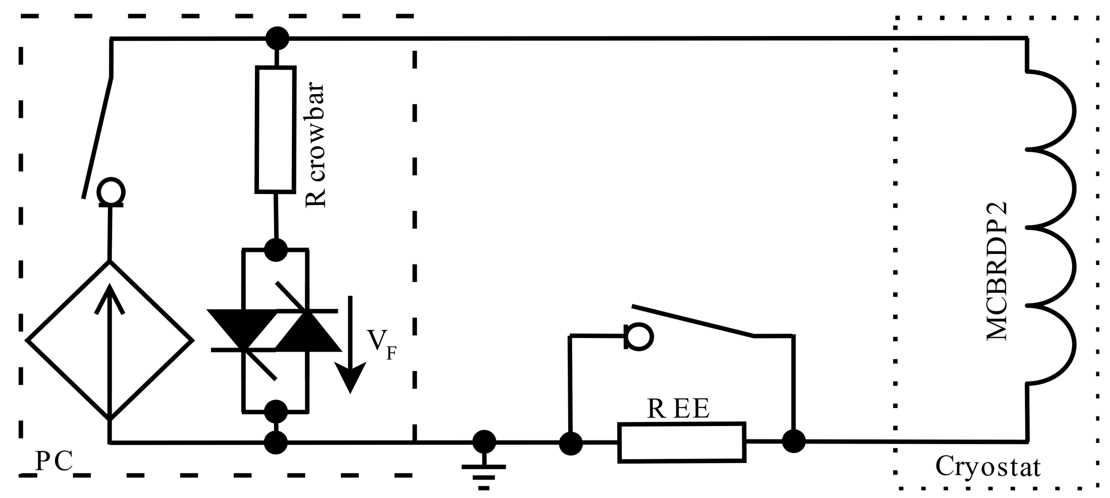
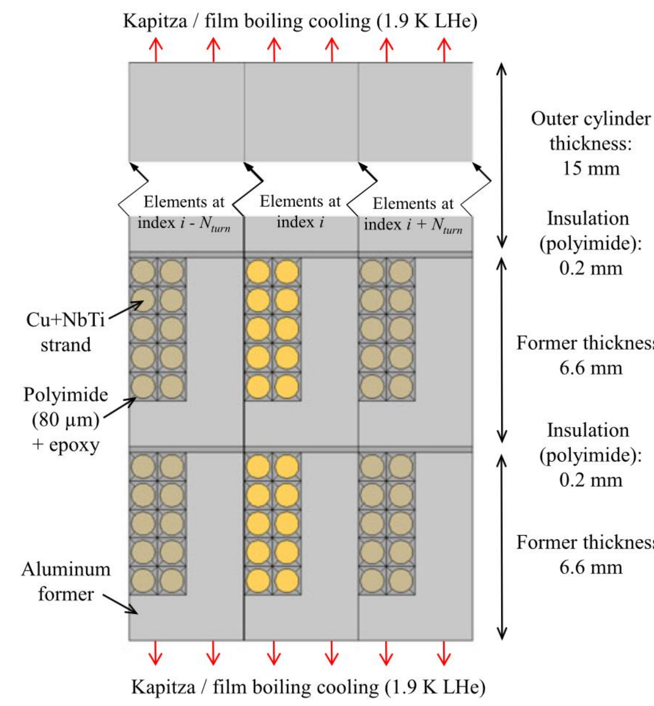
Introduction

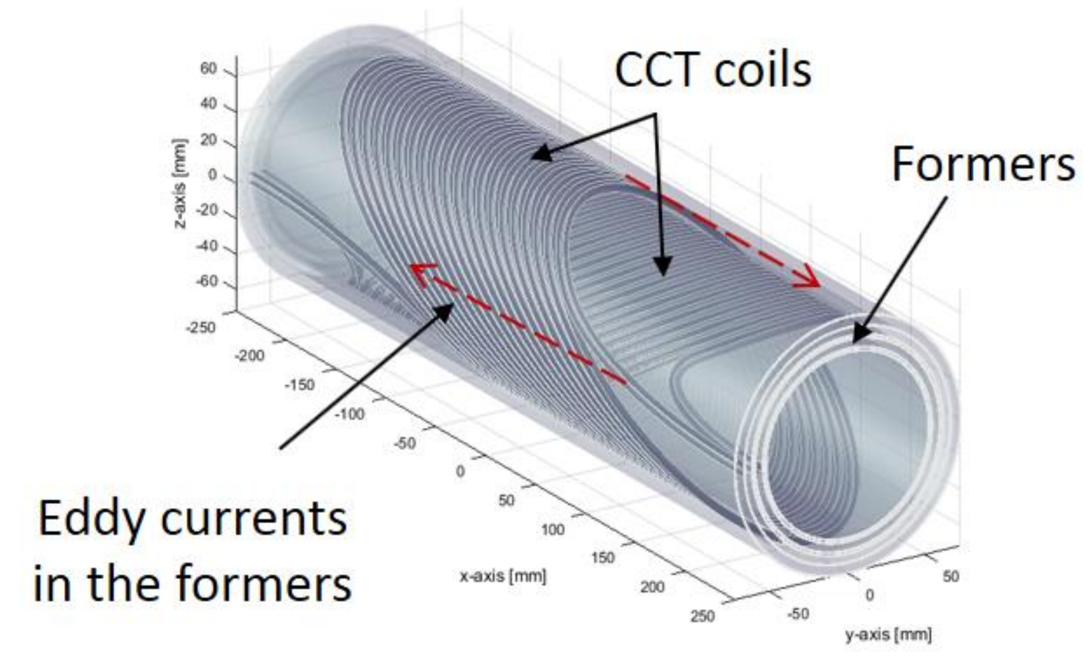
- The HL-LHC upgrade requires eight 105 mm warm bore diameter, double aperture dipole correctors (MCBRD). CERN selected a Canted Cos-Theta (CCT) design for this magnet.
- Prototype magnets were built as part of R&D on CCT magnets. This poster focuses on MRBRDP2 made by Western Superconducting Technologies Co. Ltd. (WST) in China.
- The magnet was trained to an ultimate current of 422 A at 4.0 K at the Institute of Modern Physics (IMP) of the Chinese Academy of Sciences.
- The magnet was tested at CERN at 1.9K with triggered energy extractions (EE). The apertures were powered independently in a circuit as per the schematic shown on the right.
- The triggered EE were done with resistors of: 2.0 Ω for both apertures and 1.4 Ω (the HL-LHC project protection baseline) for aperture 2.
- Below we report measurement and simulation results for the triggered EE and discuss the influence of the key model parameters on the accuracy of simulations.



Simulations

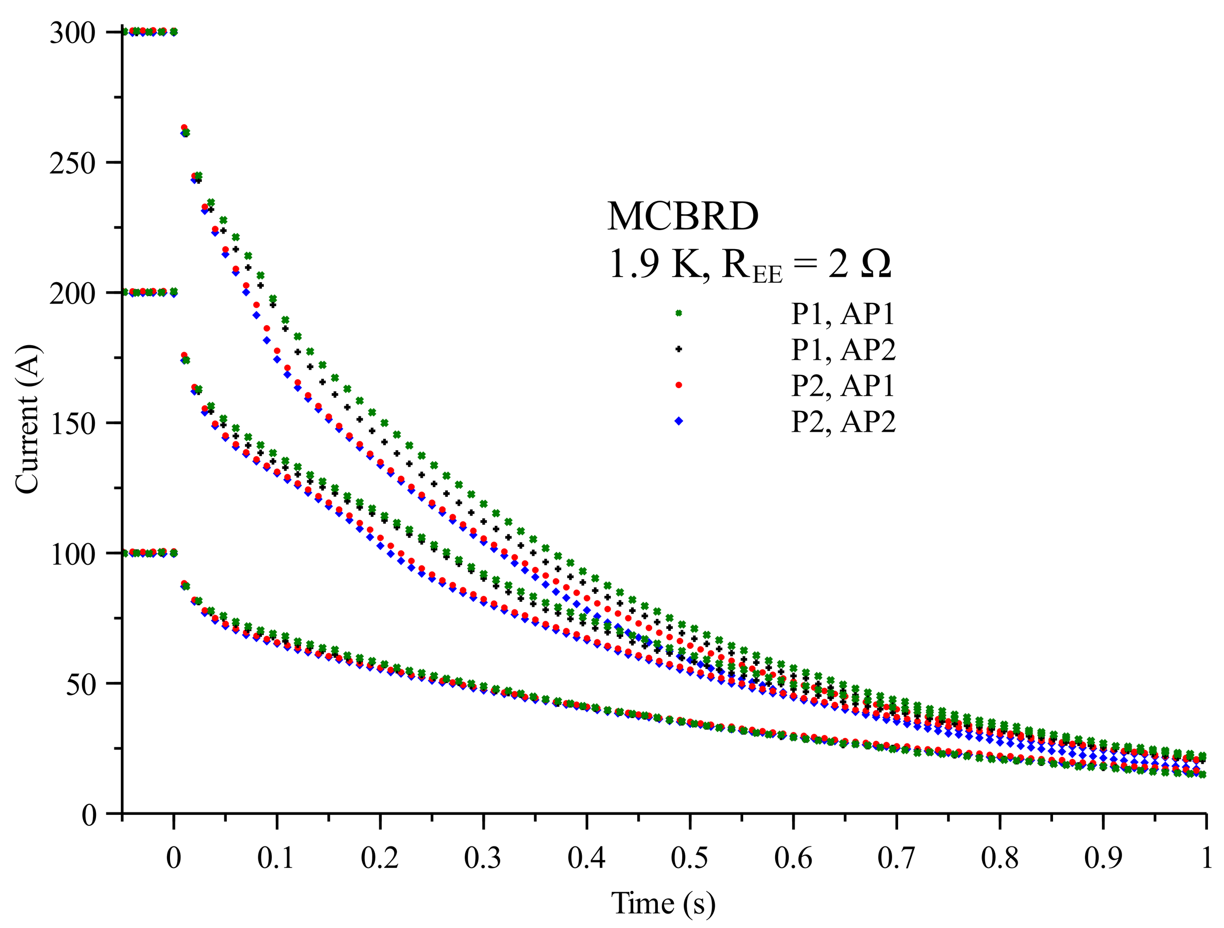
- Simulations were performed using ProteCCT software developed as part of the STEAM project: https://espace.cern.ch/steam/SitePages/ProteCCT.aspx
- The calculation method describes fully three-dimensional quench behaviour using a simplified representation of the CCT coil geometry.
- Thermal propagation along the length of the strands and the formers transverse thermal exchange is considered.
- The induced eddy currents in the formers are considered in a simplified way where it is assumed that the current distribution in formers is uniform.
- The wire used in MCBRDP2 had Cu:SC of 1.18:1. Additional measurements of former and wire RRR were performed.
- Cu RRR of the wire was measured to be 184. Measured resistivity of the aluminium alloy 6082 T6 formers was 4.69 nΩ m and 1.13 nΩ m at 273 K and 4.2 K, respectively, resulting in the measured RRR of 4.14

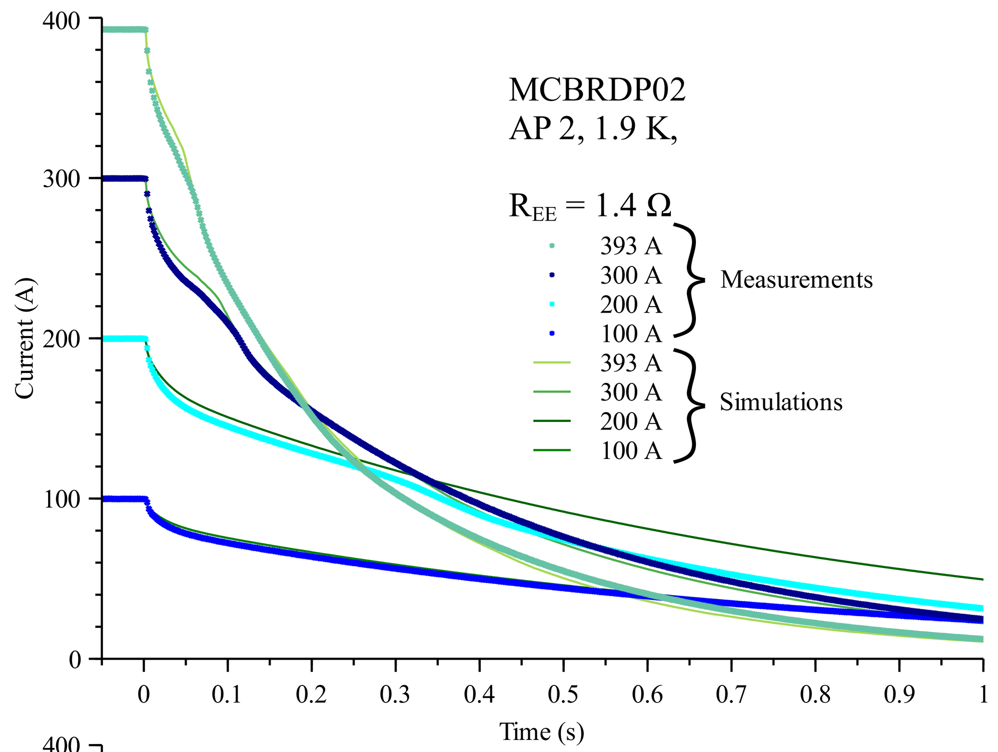


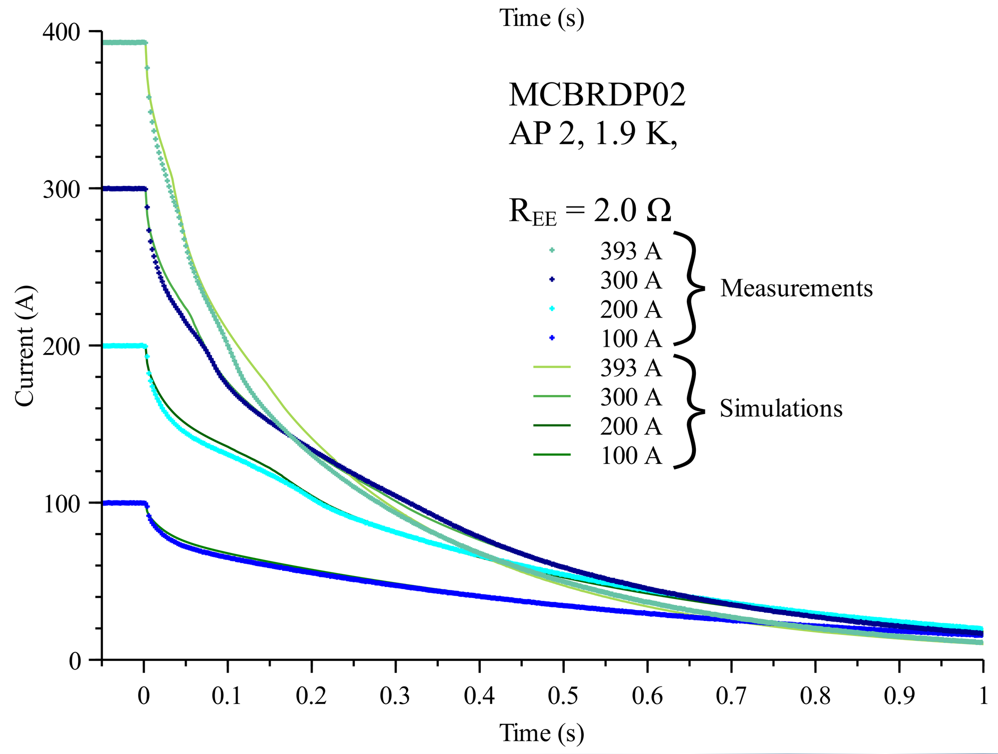


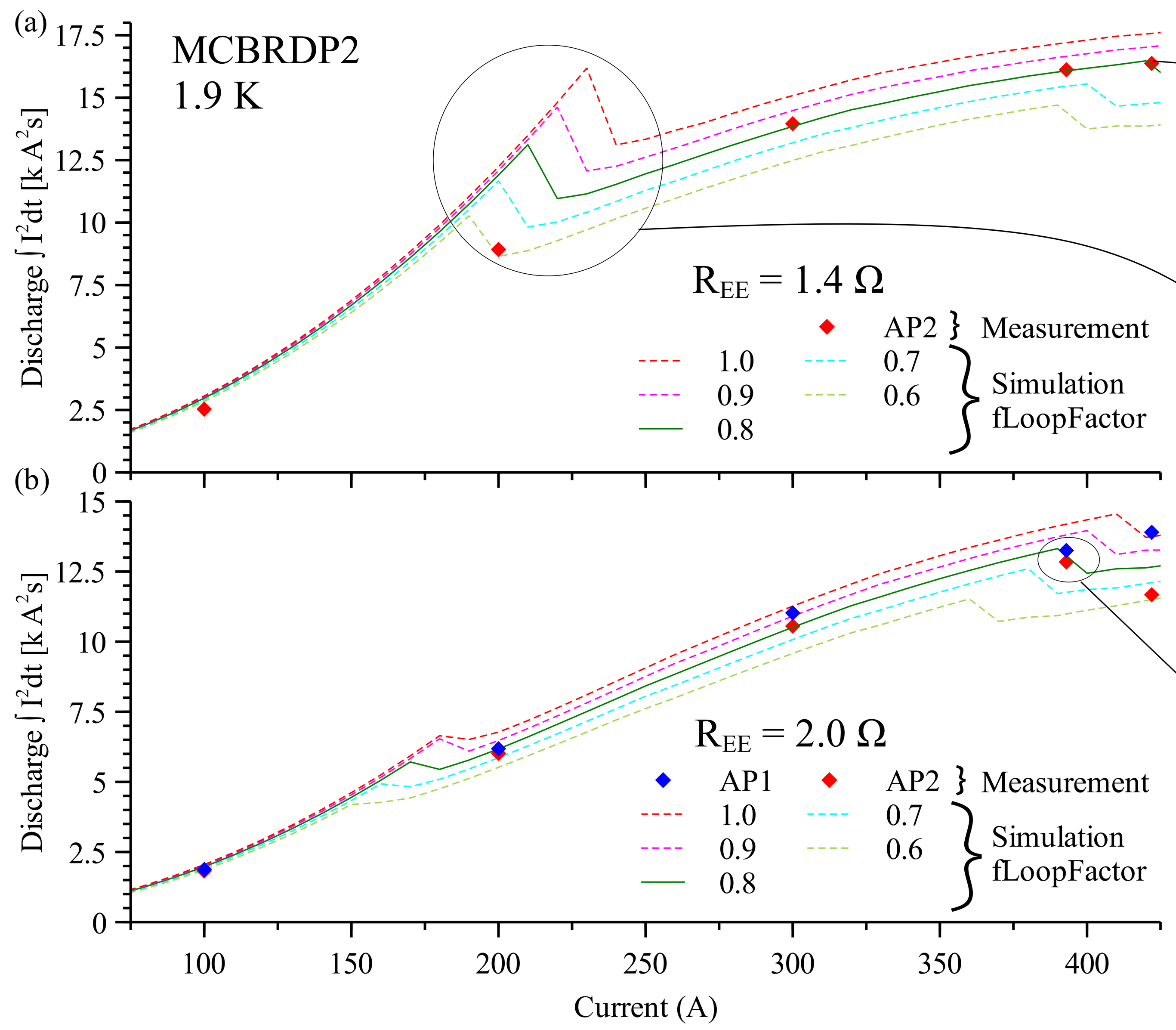
Results

- The MCBRDP2 prototype magnet discharge characteristics differ from the prototype MCBRDP1 (see figure below).
- Simulations match measured discharge behaviour when the fLoopFactor is adjusted to 0.8. This is shown as current versus time and discharge integral versus extraction current (see figures on the right).









Discharge integrals versus extraction current for 1.4 Ω and 2.0 Ω extraction resistance. Points are measured values, and lines are simulations with the fLoopFactor factor in the 0.6 to 1.0 range.