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Thu-Af-Po.07-02: Quench mitigation strategies in a FNSF scale HTS magnet

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Startup and quench behavior in a FNSF scale Toroidal Field (TF) HTS magnet were explored in a previous ASC paper. In that study a mix of superconducting and resistive materials are
arrayed in a Bitter Plate like arrangement. In the studies presented here, various quench mitigation scenarios are explored. The conductor arrangement is a parallel set of HTS channels with radially conductive/resistive materials between the channels. Additionally, resistors are included in the channels near the terminals to improve start-up current uniformity. The arrangement is intended to explore the parallel circuit design, and provide some insight into partially insulated HTS coils in a large scale reactor.
Current non-uniformity is explored vs Ramp up rates . Quench is simulated by forcing a channel to locally go fully resistive. Then current distributions in neighboring channels can be quantified. The time to quench a local region is treated in parameter studies. The time to detect the quench is also treated as a variable. Use of heaters throughout the magnet are assumed to force resistive behavior, and to provide –hopefully, a uniform heat-up of the magnet which would be below the threshold of any damage to the conductors. Thermal conductance time from heater to conductor is treated as a variable as well. Initial studies showed that there had to be some resistive conducting material between the terminals for each plate, otherwise the inductance and magnet stored energy would force an arc across the terminals. The goal is to avoid large variations in the local operating currents that might cause a cascade of quenches, and local damage of the conductors. Finite element modeling and circuit simulations are presented.

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