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Forced Flow Cooling of High Field, REBCO-Based, Fusion Magnets Using Supercritical Hydrogen and Helium

Sunday 10 December 2017 11:00 (30 minutes)

We are studying the use of REBCO High Temperature Superconductor (HTS) tape as the superconductor for the Toroidal Field (TF) magnets for a highly compact, high field fusion reactor. Very high operating currents are desirable for use in this application due to the large volumes and very high stored magnetic energy. We envision using stacked tapes of REBCO cooled by forced flow of cryogenic fluid to maintain stable operation at magnetic fields as high as 21 T and at operating temperatures in the range of 20-30 K. The main source of heating in the conductors is from neutron radiation emitted by the burning plasma. The highest heat flux is in the coil turns closest to the plasma and falls off exponentially radially through the winding pack. Several cryogenic fluids are being considered for the magnet cooling including hydrogen, helium, and neon. We describe advantages and disadvantages of each fluid, and give results of thermal-fluid analysis and computations to determine the performance limits of a conceptual design for a high field TF magnet system.

Primary authors: BARBER, Julien; BRISSON, John; Dr MINERVINI, Joseph (Massachusetts Institute of Technology)

Presenter: Dr MINERVINI, Joseph (Massachusetts Institute of Technology)

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