Conceptual Design of a Toroidal Field Coil using HTS CrossConductor

The potential of High Temperature Superconductor (HTS) for a Toroidal Field Coil (TFC) of a future fusion power plant has already been demonstrated in a conceptual design within EUROfusion [1]. One of the candidates of a high current HTS conductor for use in a fusion magnet is the so-called HTS CrossConductor (HTS CroCo) where REBCO tapes are arranged in a cross sectional optimized way.

The basic TFC dimensions have been taken from the PROCESS system code as the starting point for the design of a winding pack, consisting of six CroCos around a copper core, embedded in a stainless steel jacket and cooled by 4.5 K supercritical helium. With this cable geometry, the electromagnetic, structural mechanics, cooling, and thermo-hydraulic performance of an HTS-TFC were investigated. It could be shown that the conductor and winding pack design fulfills the requirements with respect to structure mechanics and hot spot in case of a quench. The current sharing temperature is large enough that it is possible to handle the nuclear heat load on the coil with still sufficient margin.


Co-authors: Dr HELLER, Reinhard (Institute for Technical Physics, Karlsruhe Institute of Technology); FIETZ, Walter (KIT / ITEP); Dr VOGEL, Thomas (Institute for Technical Physics, Karlsruhe Institute of Technology); Dr WEISS, Klaus-Peter (Institute for Technical Physics, Karlsruhe Institute of Technology); Dr WOLF, Michael J (Institute for Technical Physics, Karlsruhe Institute of Technology)

Presenter: Dr HELLER, Reinhard (Institute for Technical Physics, Karlsruhe Institute of Technology)

Session Classification: P1

Track Classification: Magnets and Power Supplies