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# High Temperature Superconductors for Fusion at the Swiss Plasma Center

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High Temperature Superconductors (HTS) may become in future an option for the superconducting magnets of commercial fusion plants. The general requirements for HTS conductors and coils are presented together with a tentative roadmap for the related R&D activity. The issue of the material cost and its evolution is also discussed in comparison to the Low Temperature Superconductors (LTS) option. At the Swiss Plasma Center (SPC) the R&D activity toward HTS high current, high field cable suitable for fusion magnets started in 2012 and led in 2015 to the assembly of the first 60 kA, 12 T prototype conductor. The basic component is a thin ceramic tape (0.1 mm thick, 4 mm wide) of coated conductor, generically named ReBCO and commercially available since about one decade. The main challenge for the design of high current cable is the assembly of a large number of brittle tapes in a mechanically stable configuration, able to withstand the large operating loads. The electrical requirements, tape transposition for balanced current distribution and moderate AC loss, set additional restrictions to the cable layout. The cable concept developed at SPC is based on the principle of "soldered, twisted stacks"of ReBCO tapes. The required number of stacks is then assembled in a cored flat cable, cooled by forced flow of supercritical helium. The EDIPO facility at SPC, with 12.4 T background field, 100 kA test current and 1 m long high field section, is the ideal tool for qualification of high current HTS cables, where long cable pitches, in the range of 1 m, are mandatory to control the bending and torsion strain of the ceramic tapes. To test HTS cable samples at elevated temperature, the EDIPO test environment is upgraded with a low heat conduction "adapter", inserted between the HTS sample and the NbTi based transformer. A counter-flow heat exchanger between inlet and outlet coolant allows cold gas return from the HTS sample to the cryo-plant. The first test of a HTS high current sample was carried out in 2015. The initial performance fulfilled the design target, but some degradation upon electromagnetic load cycles was observed and investigated after dismantling the cable. A new prototype HTS conductor is being now assembled at SPC with improved layout, based on the tentative spec for the high grade conductor of the DEMO Central Solenoid.

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