Some results of the EC project FASTGRID

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Abstract

The EC FASTGRID (Cost effective FCL using advanced superconducting tapes for future HVDC grids) project aims at improving the REBCO conductor to enhance its economical attractiveness, especially for high voltage devices [1]. In order to achieve this goal, three approaches are simultaneously investigated: i) the reduction of the tape length through the increase of the electric field during limitation, ii) the reduction of the tape cost through improved yield and higher critical current, iii) the lowering of the liquid nitrogen bath temperature to 65 K. We carry out a base line using an upgraded THEVA tape (> 600 A/cm-w, 77 K, without stabilizer) with high homogeneity, i.e. less than 10 % of standard deviation on the critical current over the length of the tape. Different approaches have been tried to improve the shunt layer, both with metallic and non-conductive materials. As a first solution, the research team has developed and successfully tested a conductor with a Hastelloy shunt able to withstand 130 V_{rms}/m during 50 ms at 65 K and low prospective current faults (“hot spot” regime). During the tests, the powers per unit volume and surface reached respectively 70 GW/m^3 and 44 MW/m^2. This conductor (tape + shunt) will be used in SFCL elements, pancake shape coils (≈ 1 kA – 5 kV). Two SFCL elements have been successfully tested at IPH in Berlin. The second shunt solution developed consists of a ceramic in epoxy matrix coating, which has no electrical conductivity but a high heat absorption capability. Another significant improvement of the tape that was investigated is the implementation of the Current Flow Diverter concept, which allows increasing the NZPV by one order of magnitude with respect to actual tapes, making possible to reduce the shunt thickness. The concept is based on the introduction of a tailored thin oxide layer between the REBCO and the Ag layers. To reach much higher electric fields under limitation, the FASTGRID team also developed advanced tapes based on a sapphire substrate, which can tolerate ultra-high electric fields, in the range of kV/m. Validated at laboratory scale, this game-changing technology needs to be implemented in long lengths with an industrial process. This presentation will provide an overview of the research results about the conductor architecture (tape plus shunt) and the demonstration module.

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