Application Driven Superconducting Wire and Cable Development and Application Activities/Prospects in Europe

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***Abstract*— Two different High Temperature Superconductors (HTS) are presently in the focus for a couple of upcoming applications, the $REBaCuO_x$ coated conductor (CC) tape and Magnesium-Diboride (MgB_2) wires, both available from different industries in Europe nowadays. CC tapes became recently high interest for the application at T=65-77K in resistive and inductive Fault Current Limiters (FCL), energy transmission cables, transformers and racetrack coils in the rotor windings of motors and generators. The EU-project EcoSwing addresses a full-size generator from CC-tape for application in a wind energy device which should be implemented in an existing wind farm. The tremendous increase of the current carrying capacity of CC by an order of magnitude at temperatures of lHe and the weak magnetic field dependence in that temperature regime qualified the material for applications as insert coils in high field magnets (Univ. Geneva). Special preparation routes applying tailored flux pinning reduce the field influence and favor applications in background field and solenoid geometries. The demonstration of persistent mode joints enforced in particular the interest for NMR HTS insert magnets (Bruker, Siemens AG). However many applications of CC's require much higher currents as single tapes can provide and motivated the development of different cable concepts as the Roebel-Assembled Coated Conductor (RACC at KIT), the flat Rutherford cable (EPFL) the round Rutherford style cable (ENEA) and the Conductor On Round Core (CORC - Advancedsuperconductors-USA). Main drivers for the cable development are future Fusion magnets for the DEMO fusion power plant following up ITER and future magnets for accelerators as the upgrade of the Large Hadron Collider at CERN in Geneva which are addressed in a work package of the EU-project Eucard2. From the technical requirements of such applications the material performance is faced with a couple of technical properties as high engineering currents, tolerance against mechanical load from thermal stresses and Lorentz Forces, low losses under AC operation and stability under thermal cycling and overcurrent. An overview on the cables and application relevant modifications being under investigation and development (impregnation, reinforcement etc.) and the achieved performance will be reviewed. For MgB_2 the situation is quite different since the operation temperature regime is limited to 4-25 K and the usable conductor actually to a multifilamentary powder-in-tube (PIT) wire. Low conductor costs, very long wire lengths and the prospects of cooling with liquid hydrogen (extracted from natural gas or fuel cells and liquefied with renewable energy) or maintenance free cryocoolers are strong arguments to apply this material in future. The application of MgB_2 wires is planned for bus bars in the LHC in CERN, for the rotor pancake windings of a wind generator (EU-Project SUPRAPOWER) and in a demonstrator of a HVDC power transmission cable transmitting renewable energy from offshore wind farms to consumers in cities and industrial areas (WP of the EU-project BestPaths). MgB_2 wires are actually optimized for a reliable performance and good economy with application specific development at COLUMBUS superconductors.**

***Keywords (Index Terms)*— Fault current limiters (FCL), energy transmission cables, transformers, motors, generators, accelerator, coated conductor, MgB_2.**

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