WB3-3-INV

Development and Perspectives of HTS Cable-In-Conduit Conductor with Al-Slotted Core for Fusion Applications

*Antonio della Corte[1], Giuseppe Celentano[1], Andrea Augieri[1], Marcello Marchetti[1], Sandro Chiarelli[1], Luigi Muzzi[1], Federica Pierro[2], Roberto Bonifetto[3], Nadja Bagrets[4], Angelo Vannozzi[1]

ENEA Italian National Agency for New Technologies, Energy and Sustainable Economic Development[1]
Tufts University, Mechanical Engineering Department[2]
NEMO group, Dipartimento Energia, Politecnico di Torino, Torino, Italy[3]
KIT - Institute for Technical Physics[4]

In the recent years, due to the increasing performances of the High Temperature Superconductor (HTS) REBCO-based conductors, i.e. *coated conductors*, the development of HTS based technology for extremely high field generation applications is emerging as one of the most favorable opportunities in nuclear fusion sector.

Pushed by this application perspective, new concepts of conductors incorporating HTS coated conductor tapes have been designed and implemented. Among them, a Cable-In-Conduit Conductor comprised of an Aluminum-slotted-core has been developed. In this cable the HTS tapes are stacked and inserted into helical ducts formed in an extruded Aluminum cylindrical core mostly studied in the 5-slots configuration (5 ´ 20 tapes – or 5 ´ 30, depending on tape thickness). The cable layout, designed aiming at the industrial feasibility of the manufacturing process, has shown promising electrical, thermo-hydraulic and mechanical properties assessed in several experimental studies of cable samples.

In this contribution, the status of the art of the Aluminum-slotted-core CIC conductor development will be presented. In particular, the manufacturing process, the electrical and mechanical behavior of the cable will be discussed based on the experimental results obtained in cable prototypes and numerical simulations with implemented cable FEA codes. On this basis, the most advanced concept of the cable with 6 slots and square jacket made of high strength Al – alloy has been developed. First results on the jacketing process and mechanical behavior will be provided showing how this solution is particularly suitable for fusion magnets. In this perspective, the road map of the cable development activities will be described. The layout and manufacturing details of the sample (sub-size conductor rated for 15 kA at 4.2 K and 12 T) for quench experiments to be performed in the next months at the SULTAN facility will be illustrated. In particular, preliminary experimental results of the electrical behavior and termination concept will be presented and the expected behavior of the cable described. These results supported by thermal-hydraulic/electric 1D multi-region conductor model implemented by PoliTo contributed to predict the quench propagation in HTS conductors.