

Qualification of the Resin System for the ITER Toroidal Field Coils

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Abstract - In view of the radiation environment prevailing at the location of the ITER toroidal field coils, the replacement of “traditional” magnet insulation systems, i.e. glass-fiber reinforced epoxies, by less radiation sensitive materials was found to be necessary. After detailed studies of all kinds of resin systems (various types of epoxy, bismaleimides, etc.), composites consisting of boron-free glass fabrics and polyimide layers impregnated by cyanate ester (CE) or cyanate ester – epoxy blends turned out to fulfill all the requirements set for the ITER TF coils. These are in particular (i) radiation tolerance of the electrical and mechanical properties up to twice the ITER lifetime fluence of fast neutrons, (ii) suitability for vacuum pressure impregnation, (iii) sufficiently long pot life for this purpose, (iv) reasonably low curing temperature, (v) suitability for multiple impregnations, and (vi) suitability for large scale industrial application. Among all the blends investigated, the resin consisting of 40 wt% CE and 60 wt% epoxy was found to perform best. As a consequence, a qualification program was implemented by IO with the aim of fabricating sample plates under identical conditions and testing the products provided by industrial suppliers with regard to their radiation hardness and their mechanical performance under ITER-like conditions. All four resins provided so far by companies in Europe (Huntsman), the US (CTD) and Japan (IST) passed the qualification procedures and are now fully qualified as insulation materials for the ITER TF coils.

Keywords - Bonded glass fiber / polyimide tapes, Qualification, Radiation resistant resins, ITER

IEEE/CSC & ESAS European Superconductivity News Forum (ESNF) No. 22 October/November 2012. ESNF Reference No.ST318 Category 6.

This invited ASC 2012 manuscript 4JF-01 was submitted to *IEEE Trans. Appl. Supercond.* (2013) for possible publication.