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Mon-Mo-Po1.03-07 [27]: Analysis of the heater-to-coil insulation in MQXF coils.

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In the framework of the HiLumi project, the present LHC low-β superconducting quadrupoles will be substituted with more performing ones, named MQXF. MQXF will have high peak-field on the conductor (˜12 T), therefore the Nb3Sn technology is needed in order to reach the target performance.
One of the main technological challenges for the Nb3Sn magnets is the coil fabrication: due to the brittleness of Nb3Sn, coils needs to be impregnated with epoxy resin in order to improve mechanical properties, and avoid conductor damaging. Quench heaters are necessary for quench protection, and they need to be impregnated with the coil as well, in order to be close enough to the coil itself and to reach the required efficiency. Quench heaters are insulated from the coil by a 145 μm layer S 2 Glass® and Epoxy resin, and a 50 μm layer of Kapton®.
The test of the first MQXF prototype (4 m long) has been interrupted due to a heater-to-coil short circuit. Therefore, the electrical testing procedures have been improved, and a deep analysis of the heater-to-coil insulation has been performed.
In this paper, we report the results of the heater-to-coil insulation analysis, showing the simulations of the peak voltages expected in the magnet, modelling of the insulation during quench and electrical test conditions, including failure analysis, and the experiments performed on coil sections, short coils and models, long coils and prototypes made in order to prove the robustness of the insulation. Alternatives to the present fabrication solution are also presented, showing advantages and disadvantages. The results of this analysis are of general interest for all the Nb3Sn coils impregnated together with quench heaters.

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