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Mon-Mo-Po1.02-02 [14]: Progress in Simulation Method of No-Insulation High Temperature Superconductor Magnets

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Rare earth barium copper oxide (REBCO) coated conductor has been promising conductor for the design of high field magnets due to its high strength, high critical current and high critical field. However, high temperature superconducting (HTS) magnets are challenging to protect due to slow normal zone propagation velocity (NZPV). No-insulation (NI) winding technology has been demonstrated to produce compact, reliable, stiff and strong magnets. This technology is not devoid of its own challenges either. The charging delay due to radial bypass path in NI coil is an actively researched area. To verify that such magnets are truly self-protecting and to understand other unique behaviors of NI magnets, they are modeled using "lumped circuit model"where each "sub-coil"is modeled as a single inductor with resistances in series (quench resistance, *Rq*) and parallel (characteristic resistance, *Rc*). The results obtained using this method and lessons learned are presented in this article: (1) During fast electromagnet quench propagation of NI magnets, overcurrents (currents greater than designed operating current) are produced which can overstress the magnets. (2) Variation of *Rc* with temperature and magnetic field can influence the magnet voltage. (3) In asymmetric quench of nested NI magnets, the axial centering force can be large and need to be considered. (4) Screening current and its effect in field homogeneity and magnet stress is also an important challenge unique to NI magnets. Despite the challenges, the work presented here shows that it is possible to construct high field magnets using NI REBCO technology after careful consideration of these challenges and lessons learned which will be beneficial for advancing the area of HTS magnet development.

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