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M3Or2B-03: Modeling current sharing and protection in a coated conductor-wound racetrack coil with various interlayer contact resistance values

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A no-insulation approach is now of great interest for use in magnets and coils made with YBCO coated conductor. The low inter-strand electrical resistance allows current sharing between layers of the coil, and the associated high thermal conductivity allows for thermal sharing. However, it is of interest to know what actual level of layer to layer electrical and thermal conductivity is needed in order to promote current sharing, thermal sharing, and increase coil survivability, while not degrading the inductance of the coil. In this paper we present a Finite Element Method (FEM) analysis of current sharing in a race track coil wound using YBCO coated conductor tape with different values of inter turn resistance. In the modeling a mechanical defect was created in YBCO film and a current sharing was modeled. In addition to the two limiting cases –a "perfectly"insulated tape and a "perfectly"non-insulated tape (i.e. touching surfaces of the neighboring turns), we explored various intermediate electrical and thermal contact values. We compared these values to what is typically seen in between coated conductors under various preparation conditions, We then compared current sharing in coils vs current sharing in cables, allowing us to describe the difference between what provides a useful level of current sharing in coils as opposed to cables. This also allows the development of scaling rules for different size magnets.

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