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Numerical Modelling of AC loss in large HTS Coils

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Over the past decade High Temperature Superconductors (HTS) have gained interest for use in large scale coils for fusion applications. It is necessary to use a cable consisting of multiple parallel tapes in order to reduce the coil's inductance and to mitigate point defects. In many fusion and also non-fusion cable concepts the tapes are often transposed to reduce AC-losses. However, it has been theorized that this is not needed from an AC-loss perspective. Since this unnecessarily complicates coil manufacturing, it has been proposed at Tokamak Energy (TE) to use a non-twisted stack of tapes, a technique which has already been successfully applied to smaller solenoids. As a step towards larger more fusion relevant coils, a toroidal magnet named Demo4 is currently under construction at TE, using a similar stacked tape approach. To perform an in-depth analysis of AC-losses in Demo4 and future magnets, a new electro-magnetic and thermal network model named Raccoon was developed at Little Beast Engineering. This model is capable of calculating 3-dimensional screening current, coupling current and transport current effects at tape level detail in a full-scale magnet. Raccoon can also be used for quench analyses. In this paper the calculated time-dependent current distribution and corresponding losses in the Demo4 coil-set will be presented, and the effects of the non-transposed cable will be investigated.

Primary authors: Dr VAN NUGTEREN, Jeroen (LittleBeast Engineering); Dr BATEMAN, Rod (Tokamak Energy Ltd); Dr BRISTOW, Matthew (Tokamak Energy Ltd); BRITTLES, Greg (Tokamak Energy); KRUIP, Marcel (Tokamak Energy); Mr VAN NUGTEREN, Bas (Tokamak Energy Ltd); Mr SLADE, Robert (Tokamak Energy Ltd)

Presenter: Dr VAN NUGTEREN, Jeroen (LittleBeast Engineering)

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