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EXCTRACTING RELEVANT TRANSPORT PROPERTIES USING 3D CFD SIMULATIONS OF SHELL-TYPE ELECTRIC TRANSFORMERS

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ABSTRACT The shell-type electric transformers are designed and manufactured in order to guarantee the evacuation of internally dissipated energy while maintaining its operation within safe and reliable temperature limits. The energy evacuation is accomplished by circulating a high heat capacity cooling fluid through a set of well-defined interconnected cooling channels that guide it.

In this work the fluid flow and temperature fields in these cooling channels are comprehensively analyzed for different boundary conditions using 3D CFD simulations conducted in the commercial code ANSYS Fluent®. Different channel aspect ratios have been modelled varying the calculation domain height. The calculation domain has been scaled down by a factor of 1:3 in order to be in the future compared with an existing experimental apparatus.

From the CFD results it is observable that the relative mass of cooling fluid being distributed among the cooling channels is almost independent of the flow rate. That distribution is observed to be identical for a wide range of total mass flow rate values, under laminar flow conditions. Instead, for increasing flow rates, the mass distribution inside each channel becomes more heterogeneous alongside with the onset of recirculation patterns corresponding to low fluid velocity areas wherein higher local temperatures are expected.

At the end of this work relevant momentum and heat transfer properties are extracted from the CFD simulations, such as Friction Factors and Nusselt numbers. A comparison against adequate literature results shows reasonable agreements, hence validating the methodology and enabling further work.

The information herein obtained is of paramount importance for implementation in reduced-order modelling techniques that depend on correlations of these basic transport properties.