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P3.804 Steady-state transverse heat transfer in a single channel CICC

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Current models used for thermal–hydraulic analyses of forced-flow superconducting cables, used in the fusion technology, such as, e.g. Cable-in-Conduit Conductors (CICCs), are typically 1-D. They require reliable predictive expressions for the transverse mass-, momentum- and energy transfer processes between different cable components, in order to reliably simulate the behavior of any superconducting magnet design either in normal operating conditions or during a quench evolution. Only few heat transfer correlations for flow in a CICC bundle have been proposed in the literature, but none of them is widely accepted for predictive purposes. As a result, in thermal-hydraulic studies of conductors designed for the EU-DEMO coils standard heat transfer correlations for flows in smooth tubes are used, which are undoubtedly over-conservative in this case. Systematic measurements of heat transfer coefficients in a CICC bundle should be performed to provide an experimental database for further attempts to develop a predictive correlation. In 2017 we performed first preliminary measurements of the steady-state heat transfer coefficient between a jacket wall and fluid flowing (i) in a smooth tube and (ii) in a CICC bundle of the reference sample (JT60SA TF conductor). Based on these preliminary results, recently we improved the experimental configuration, and we performed further systematic measurements of the heat transfer coefficient at various values of the water inlet temperature and mass flow rate, to obtain the results in a wide range of Pr and Re numbers. We also made some attempts to improve the heat transfer model used in the experimental data analysis. These new results are discussed in the present paper.

Presenter: HERBIN, Paweł (Institute of Physics Faculty of Mechanical Engineering and Mechatronics West Pomeranian University of Technology)

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