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Methods and strategies on thermal integrity management of the ITER Thermal Shield

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Due to its main function as provider of a thermal radiation opaque barrier to the superconducting magnets, the ITER Thermal Shield (TS from now) design guarantees an appropriate thermal behaviour during operation. All the methods and strategies implemented with this purpose on the design, manufacturing and assembly of the TS, constitute the so called TS Thermal Integrity Management. The scope of this paper is to provide a comprehensiveness description of the TS Thermal Integrity Management keeping focussed on three main aspects: last methodology for an accurate estimation of the TS heat loads; advanced thermo-hydraulic modelling; combined analytical-experimental method for sizing pipe orifices. The TS heat loads estimation has to be accurate in order to know the margins regarding the agreed limits with the Cryoplant and Magnets. The proposed methodology includes detailed thermal radiation view factors involving all the systems interfacing with the thermal shield. This methodology is applied on a simplified case and compared with previous methods, resulting on a better understanding of the level of conservatism and the accuracy of the estimated heat inputs on the TS. A detailed analysis of the coolant temperature rise on the cooling tubes is also described in combination with experimental data and fluid-dynamic analysis of the required pipe orifices. As a result, a pipe orifices sizing method is described and new thermo-hydraulic parameters are found for feeding the planned final flow balance analysis of the thermal shield. As a conclusion of the paper, it is presented how the described methods are integrated onto the strategy that aims to manage the actual component emissivity data, being a strong tool for assessing the impact of the silver coating quality (during manufacturing and assembly) on the expected TS thermal behaviour. The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.

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