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Cooling optimization of the electron cyclotron upper launcher blanket shield module

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The four ITER EC (Electron Cyclotron) Upper Launchers inject up to 8 MW microwave power each with the aim to counteract plasma instabilities during plasma operations. The structural system of these launcher antennas will be installed into four upper ports of the ITER vacuum vessel.

The structural part of the Upper Launchers which forms the plasma facing component is called the Blanket Shield Module (BSM) that during operation will be heated by nuclear heating from neutrons and photons, thermal radiation from the plasma and mm wave stray radiation. The BSM is classified as an ITER VQC1 component since together with its cooling system it is fully immersed into the torus vacuum environment.

Recently Fusion for Energy has started the manufacturing of a full scale prototype of the BSM with the objective of finding an optimum manufacturing route including both technical and economic aspects.

This paper describes the design changes that have been implemented for the optimization of the BSM cooling performance by adapting the design and manufacturing route according to the know-how of the prototype supplier (ATMOSTAT) of Hot Isostatic Pressure (HIP) technologies. In particular, a highly efficient flange cooling scheme has been implemented.

This paper also details the design process that has driven the cooling optimization, including finite element steady state thermal analysis and CFD (Computational Fluid Dynamic) analysis. Specifically CFD was used for balancing the flow of the parallel water channels.

Finally this paper illustrates experimental tests results of the qualification mockups used to validate the HIP procedures proposed by ATMOSTAT.

Co-authors: Dr PACHECO, Jose (Fusion for Energy); Dr GAGLIARDI, Mario (Fusion for Energy); Dr CAU, Francesca (Fusion for Energy); Dr PIJOAN, Roger (Fusion for Energy); Dr BOUVIER, Erwan (ATMOSTAT); Dr BOUQUET, Nicolas (ATMOSTAT); Dr CONCHON, Denis (ATMOSTAT); Dr SPAEH, Peter (Karlsruhe Institute of Technology); Dr WEINHORST, Bastian (Karlsruhe Institute of Technology)

Presenter: Dr PACHECO, Jose (Fusion for Energy)

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