FIRST WALL THERMAL ANALYSIS OF THE US-ITER DUAL COOLANT Pb-17Li LIQUID (DCLL) TEST BLANKET MODULE DESIGN

G. Sviatoslavsky, University of Wisconsin-Madison, Madison, WI 53706
M. Dagher, P. Calderoni, University of California-Los Angeles, Los Angeles, CA
C.P.C. Wong, General Atomics, San Diego, CA 92186
greg@engr.wisc.edu

In support of the ITER Test Blanket Module (TBM) program, the US team is developing a dual coolant Pb-17Li liquid Breeder (DCLL) blanket design. The US-ITER TBM design uses a reduced activation ferritic steel (RAFS) as the structural material, which limits the maximum steel structure temperature to 550C. The design utilizes two counter flowing helium circuits, with each circuit making fives passes of the first wall (FW) to remove heat flux in the FW.

Three dimensional Computational Fluid Dynamic (CFD) calculations using the commercial software FLUENT, were performed to evaluate the thermal performance of the FW, specifically, the maximum first wall temperature, helium outlet temperature and the heat transfer coefficients in the channels. The FW is represented by modeling a single channel (out of eight) for each of the five passes of the two counter-flowing helium circuits. Therefore, the eighty channel FW is simplified to a ten channel model.

The counter flow aspect of the FW requires two helium circuits and significantly increases the complexity of the manifold design of the system. Therefore, in addition to an analysis of the two circuit counter flowing design, using the same geometry, we will analyze the thermal performance of a single circuit non-counter flow design. By comparing the results of the two models, this paper will quantify the thermal advantages of a counter flowing helium cooling system compared to the performance of a simple single circuit system.