FLUID DYNAMIC AND THERMAL ANALYSES OF THE HCPB TBM BREEDER UNITS

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The overall objective of the European EUROBREED training program (Breeding Blanket Developments for Fusion Reactors) is helping to provide the necessary broad expert basis to successfully conduct the European breeding blanket development along with ITER and beyond ITER. In particular, within the EUROBREED plan, the Work Package 1 is dedicated to the Design, procurement and test of solid Breeder Units (BU).

The BU is the most important sub component of the TBM to gain experimental data with regard to the behavior of breeding materials for fusion reactors. The BU is a steel structure which contains and cools the neutron multiplier (in form of Beryllium pebbles) and the ceramic Tritium breeding material (in form of Lithium Orthosilicate or Lithium Metatitanate pebble beds).

The validation of the BU design requires a complex testing program with the use of dedicated mock ups and experimental facilities. All over the 3 years program the task of the trainee is to design, procure and test a BU mock-up. During the current 1st year, the activity is strongly related to the design of the BU, which consists mainly in performing fluid-dynamics and thermo-mechanical simulations in order to dimension the BU components. In the 2nd and 3rd year the trainee will have to follow the industrial production in a company and to co-ordinate an experimental campaign in a Helium facility.

The preliminary design of the HCPB TBM BU has been provided within the preliminary design of the HCPB TBM in a vertical arrangement. Taking into account the results of the neutronic analyses performed for the vertical HCPB TBM, the BU design has entered in its detailed phase. The detailed design of the BU furnishes the power generated in the BU material and deposed on the TBM box structures (a key boundary condition for the design assessment of the TBM box). Detailed thermal analyses of the BUs and fluid dynamic analyses of the BU CPs have been performed and are presented in this paper. The choice of the thermal and fluid dynamic design parameters and their related level of DEMO relevancy are discussed.