Application of the Best-Estimate Model Calibration and Prediction through Experimental Data Assimilation methodology to the tests performed on a Helium Cooled First Wall Mock-Up

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As part of the general strategy for the qualification of the DEMO design in view of licensing and operation, experiments are under progress at the Karlsruhe Institute of Technology (KIT). These experiments are part of the program on the qualification of components and on the validation and calibration of the RELAP5-3D models reproducing such components.

In 2018, thermal-hydraulic investigations have been performed looking into the transient response of a helium-cooled blanket First Wall (FW) mock-up under LOFA conditions. The results obtained through these investigations captured the quick temperature rise on the surfaces exposed to heat loads (such as those coming from the plasma).

The outcomes of this experimental activity are the basis of the present work, which describes the validation and calibration of the FW mock-up RELAP5-3D model using the Best-Estimate Model Calibration and Prediction through Experimental Data Assimilation methodology. This methodology is a rigorous procedure based on the maximum entropy principle and Bayes' theorem to compute best-estimate predictive results: it assimilates the computed results and the experimental data together with their uncertainties to provide "best-estimate" responses (i.e. computed results) and parameters (i.e. input deck data). In a previous work, the same methodology was used to calibrate a RELAP5-3D model of the HELOKA-HP electrical heater under normal operation. In this regard, the present work marks the first application of this methodology against incidental (fast) transients in the field of fusion reactors.

Keywords: First Wall mock-up, Best-estimate, Pressure drops, LOFA

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