Analysis of a LOFA in the EU DEMO Breeding Blanket

Introduction

The EU DEMO tokamak fusion reactor is a proposed design of demonstration fusion power plant, and it will be the first fusion facility to include a Breeding Blanket (BB) aimed at producing more tritium than that consumed by the fusion reactions. Consequently, one of the major challenges of the EU DEMO project is the design of the BB, for which several concepts are being investigated; the two most promising technologies are the Helium-Cooled Pebble Bed (HCPB) and the Water-Cooled Lithium-Lead (WCLL).

For the design of the BB, both nominal transients and accidental scenarios are to be simulated via numerical tools. The GETTHEM code [1][2] (see Figure 1), developed at Politecnico di Torino, is one of the codes employed to this task within the EUROfusion Consortium; it has been applied in the past to both operating and off-normal condition analyses, in particular focusing on Loss-Of-Coolant Accidents.

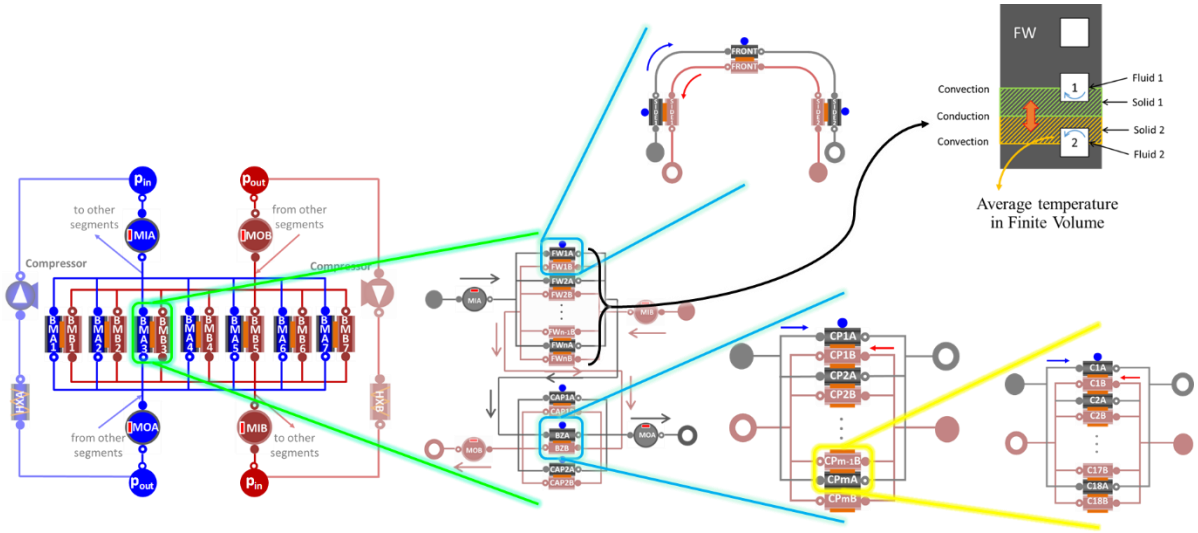

Figure 1: Scheme of the GETTHEM model of the HCPB cooling system.

Aim of the work

Another accidental sequence to be considered is the Loss-Of-Flow Accident (LOFA), which may be caused by different initiating events (e.g. channel obstruction, circulator trip, loss of offsite power, …). Such an accident would induce overheating of the BB structures (because of decay heat), and would be particularly severe in case the detection system would fail and the plasma is not shut down.

The aim of this proposal is to analyze parametrically with the GETTHEM code a LOFA in the EU DEMO BB with HCPB and WCLL BB concepts, considering different initiating events and hypotheses on the mitigation system intervention. The final outcome of the analysis should be the maximum temperature reached in the BB in the different cases analyzed.

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References

[1] A. Froio, C. Bachmann, F. Cismondi, L. Savoldi, R. Zanino, “Dynamic thermal-hydraulic modelling of the EU DEMO HCPB breeding blanket cooling loops,” Progress in Nuclear Energy 93:116-132, 2016.

[2] A. Froio, F. Casella, F. Cismondi, A. Del Nevo, L. Savoldi, R. Zanino, “Dynamic thermal-hydraulic modelling of the EU DEMO WCLL breeding blanket cooling loops,” Fusion Engineering and Design 124:887-891, 2017.