Contribution ID: **568** Type: **not specified**

P4.233 Benchmark of in-vessel Loss-Of-Coolant-Accident models for an EU DEMO helium-cooled blanket: GETTHEM vs. RELAP5-3D

Thursday, 20 September 2018 11:00 (2 hours)

The EU DEMO reactor, under pre-conceptual design within the EUROfusion Consortium, should produce several MW electrical power from nuclear fusion by the 2050s. DEMO shall be equipped with a Primary Heat Transfer System (PHTS) to remove the thermal power deposited in the plasma-facing components and convert it into electricity, and the associated safety-related components and subsystems require detailed investigations for sizing and safety considerations. Among such subsystems, the Vacuum Vessel Pressure Suppression System (VVPSS) is the system responsible for the mitigation of the in-vessel Loss-Of-Coolant-Accident (in-VV LOCA), consisting in a primary coolant ingress inside the VV due to a break in the FW, divertor or VV. The GEneral Tokamak THErmal-hydraulic Model (GETTHEM) code is being used to analyse the VVPSS behaviour during different in-VV LOCA scenarios. GETTHEM is a fast-running, system-level, transient thermal-hydraulic code developed at PoliTo; although the code is proving useful in performing parametric studies, providing feedbacks to the design teams, the reliability of its predictions should be assessed through a validation process. While the model has been validated against experimental data for an in-VV LOCA scenario for a water-cooled DEMO BB, here the GETTHEM VVPSS model for a helium-cooled BB is benchmarked against RELAP5-3D, which is widely accepted as a certified nuclear thermal-hydraulic computational tool – including applications to fission power plants. Different scenarios, including the presence of isolation valves in the primary loops, which could help mitigating an in-VV LOCA, are modelled with the two codes. The outcomes of the two tools are compared, in terms of the pressure transient in the VV, with particular reference to the peak value, which has to be kept below the maximum pressure allowed for the VV and which defines the acceptable break sizes for a feasible configuration of connections between VV and expansion volume; the discrepancies are then discussed.

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Session Classification: P4