Transient cooling of reactor vessel wall during LOCA

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Key Words: *CFD, FVM, PTS, LOCA*

The article describes a multistage modelling methodology proposed by the author for the modelling of emergency core cooling processes. The methodology is based on the best practice guidelines presented by the IAEA, it is applied to a specific scenario of emergency core cooling during a loss of coolant accident[1] with an effective break diameter of 20mm.

A 3D thermohydraulic analysis was performed as the first step in the solution process, where the transient changes in the pressure, velocity and temperature fields within the reactor pressure vessel were studied [2]. The transient CFD analysis simulated the fluid structure interaction between the coolant and the reactor pressure vessel wall. This interaction focused on the thermal field and the unsteady cooling processes. The primary knowledge learned when processing the results of the first step, was the presence of an oscillating cold coolant stripe in close proximity to the pressure vessel wall.

The next step in the methodology consisted of a three-dimensional thermo-mechanical analysis of the reactor pressure vessel [3]. In this step, pressure thermal shock induced critical zones of mechanical loading were identified and the influence of the oscillatory character of the cold stripe on the pressure vessel was studied.

ACKNOWLEDGEMENT

This work was supported by the Slovak Research and Development Agency under the contract No. APVV-19-0406, by Grant Agency VEGA, grant No. 1/0416/21 and by Grant Agency KEGA, grant No. 011STU-4/2020.

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