Modelling the Effects of Pressure Thermal Shock in a Nuclear Reactor

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Abstract. Modelling and simulation of physical and technological processes using computational numerical methods available in today's information age represent an excellent tool for the detailed study of experimentally difficult to replicate, transient processes. The problematics of emergency core cooling of a nuclear reactor core can be considered as such a process. The process of Emergency Core Cooling is realized by the supply of relatively cold coolant to the core region with the goal of maintaining its thermal management. During the process of emergency core cooling there is a continual mixing of coolant flows with differing temperatures in the immediate proximity of the reactor pressure wall, which is thereby exposed to a pressure thermal shock. This article presents a three-dimensional thermo-mechanical analysis of the reactor pressure vessel. The analysis is based on the results of 3d thermohydraulic analysis of an emergency core cooling scenario during a loss of coolant accident with an effective break diameter of 20mm. 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. The analysis consisted of a fracture mechanics analysis of postulated defects during the simulated scenario.