

Natural Circulation in a Pressurized Water Reactor with a Combined Single and Two-Phase Mode

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Abstract - In this paper, a theoretical model is used to analyse the natural circulation phenomena relevant to small breaks for PWRs. The model utilizes the one-dimensional approach and the quasi-steady hypothesis and solves analytically the loop momentum balance together with the conservation of mass and energy, and develops expressions for the core flow rate, core inlet and outlet temperature, and core temperature difference as a function of primary pressure. The model should be capable of analysing the combined single and two-phase mode of natural circulation during a small break LOCA without High Pressure Emergency Core Cooling (ECC) Injection. Also, the model is used to investigate the effect of core power on the analytical solution. The results of this paper are compared with a previous experimental result and show a reasonable agreement.

Keywords: Natural circulation; PWR; LOCA; Single phase; Two phase