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Numerical Solution of Transient Natural Convection in Vertical Heated Rectangular Channel between Two Vertical Parallel MTR-Type Fuel Plates

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Abstract : The aim of this paper is to perform, by mean of the finite volume method, a numerical solution of the transient natural convection in a narrow rectangular channel between two vertical parallel Material Testing Reactor (MTR)-type fuel plates, imposed under a heat flux with a cosine shape to determine the margin of the nuclear core power at which the natural convection cooling mode can ensure a safe core cooling, where the cladding temperature should not reach a specific safety limits (90 °C). For this purpose, a computer program is developed to determine the principal parameters related to the nuclear core safety, such as the temperature distribution in the fuel plate and in the coolant (light water) as a function of the reactor core power. Throughout the obtained results, we noticed that the core power should not reach 400 kW, to ensure a safe passive residual heat removing from the nuclear core by the upward natural convection cooling mode.

Keywords : buoyancy force, friction force, finite volume method, transient natural convection
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