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Thermo-hydraulic study using CFD from the core of a Pebble Bed Reactor (HTR-10)

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Very High Temperature Reactor (VHTR) designs of Generation IV, offer promising performance characteristics; they can provide sustainable energy, improved proliferation resistance, inherent safety, and high temperature heat supply. The 10MW High Temperature Reactor-Test Module (HTR-10) is a pebble bed reactor (PBR). To achieve the commercialization of these reactors in the nuclear industry, it is necessary to take into account very important factors such as safety, because the investigation of their thermo-hydraulic characteristics is a key tool for the design and safe operation of VHTR. Currently the use of codes of Computational Fluid Dynamics (CFD) for the deterministic safety analysis of nuclear reactors have been increased, because it is a tool able to describe in detail the thermal-hydraulic phenomena occurring in the cooling system of the reactor core. In this paper from CFD models (porous and / or realistic) is described with good accuracy the thermal-hydraulic behavior of the reactor core HTR-10 at steady state and the results are compared with a benchmark. The maximum temperature values in the porous medium model were reached at the reactor core outlet, specifically in the central zone. Therefore, the realistic simulation was performed in that region, in order to verify the behavior of the maximum temperature reached by the fuel, which do not exceed the allowable limit for this type of nuclear fuel. The results obtained are consistent with the results presented by other authors using other techniques and simulation models.

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