Optimization of a pebble bed configuration for quasi-direct numerical simulation

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A high temperature reactor (HTR) is envisaged to be one of the renewed reactor designs to play a role in nuclear power generation including process heat applications. The HTR design concept exhibits excellent safety features due to the low power density and the large amount of graphite present in the core which gives a large thermal inertia in the event of an accident such as loss of coolant. However, the possible appearance of hot spots in the pebble bed cores of HTR may affect the integrity of the pebbles. This has drawn the attention of several scientists to understand this highly three-dimensional complex phenomenon. A good prediction of the flow and heat transport in such a pebble bed core is a challenge for CFD based on the available turbulence models and computational power. Such models need to be validated in order to gain trust in the simulation of these types of flow configurations. Direct numerical simulation (DNS), while imposing some restrictions in terms of flow parameters and numerical tools corresponding to the available computational resources, can serve as a reference for model development and validation. In the present article, a wide range of numerical simulations has been performed in order to optimize a pebble bed configuration for quasi-DNS which may serve as reference for validation.

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