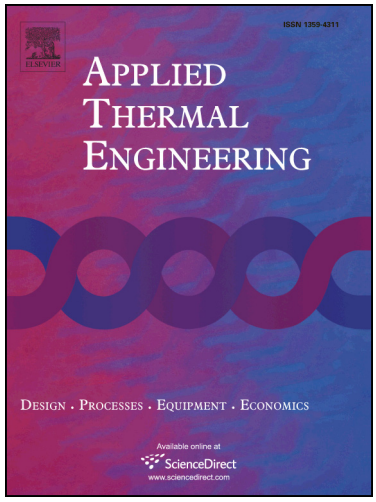

Research Paper

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Development of a sub-channel thermal hydraulic analysis code and its application to lead cooled fast reactor

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ABSTRACT

The most important candidate for 4th generation nuclear system is lead or lead alloy cooled fast reactor. In the design phase of a lead cooled reactor, it is a top priority to finish the analysis work for the core. The detailed sub-channel analysis code KMC-Sub (Keda multi-physics and multi-scale coupling platform) has been developed to analyze steady state thermal hydraulic issues of SNCLFR-100 (Small Modular Lead-cooled Natural Circulation Fast Reactor, which was designed by University of Science and Technology of China). The model used in this code had taken the influence of cross flow into account, both forced and natural circulation can be simulated, to assess the development status of KMC-sub, experimental data from ORNL 19 pin tests (sodium cooled) and CAS 61 rods test (lead bismuth eutectic cooled) are compared to results from the code. The author found that in most flow rate and power density regime, the results coincides well with the tests data. After the V&V work, the code was used to analyze the flow and temperature distribution in important assemblies of SNCLFR-100 core, which showed that the design is reasonable and feasible.

Keywords: Nuclear energy; Thermal hydraulic; Sub-channel analysis code; Lead cooled fast reactor.

1. Introduction

As one of the six most potential reactor types proposed by The Generation IV International Forum (GIF), lead or lead alloy cooled fast reactor (LFR) has drawn much attention due to its capability of nuclear waste transmutation and fuel breeding, and the properties of good safety and economic practicability [1]. The concept of lead alloy cooled fast reactor was put forward during the same period with sodium cooled fast reactor [2]. In recent years, the technical innovations in anti-corrosion materials, oxygen concentration control and other key technologies, make lead alloy fast reactor more acceptable as commercial nuclear power plant. Compared with sodium cooled fast reactors, LFR has many attractive advantages: lower chemical activity and higher stability, no combustion when direct contact with water or air, avoid the tough issue of