Seminarium Zakładu Energetyki Jądrowej
i Analiz Środowiska (UZ3)
środa 09.05.2018 godz. 10:00
PNT-NCBJ, sala 251 (PROTON)

Afaque Shams[1] and Tomasz Kwiatkowski[2]

[1]Nuclear Research and Consultancy Group (NRG)
[2]National Centre for Nuclear Research (NCBJ)

Towards the Direct Numerical Simulation of a closely-spaced bare rod bundle

Streszczenie:

The coolant flowing through the channels within the fuel assembly removes the heat generated by the nuclear fission. In an ideal scenario, the temperature distribution through the fuel assemblies should remain uniformly distributed under normal operating conditions of a nuclear reactor. However, in reality this doesn't happen and accordingly it leads to inter-subchannel mixing phenomena. The unsteady axial flow pulsations/structures, which appear in the bare rod bundle configuration, have been investigated (experimentally and numerically) over the last 50 years and remains a topic of interest up to the present time.

Although the majority of studies of flow and heat transfer inside the fuel rod bundles have been performed experimentally, most of them are conducted on the simplified/idealized geometries and under conditions that are not the same as in normally operating reactors. Moreover, the measurement of the flow properties was very often limited to a single plane or to several line traverses. It is worth mentioning, that the measurement techniques are constantly getting improved, however, the CFD-grade experiments of flow mixing and heat transfer in the subchannel scale are often impossible or quite costly to be performed. In addition, lack of experimental databases makes it impossible to properly validate and/or calibrate the available RANS turbulence models. In that context, Direct Numerical Simulation (DNS) can serve as a reference for model development and validation. However, despite the advancement in the super computing, performing a DNS for a realistic rod bundle at a high Reynolds number is not foreseeable in the near future. In this regard, a research program has been set-up between National Centre for Nuclear Research (NCBJ) and Nuclear Research

and Consultancy Group (NRG) to generate a high quality DNS database for a rod bundle configuration.

The present work is a part of this research program with an aim to design a numerical experiment for a tight lattice bare rod bundle case using different Prandtl fluids, which will be used in order to generate a DNS reference database. This takes into account the turbulent mixing and the evolution of the temperature distribution for fluid flow. In this regard, a wide range of URANS simulations are performed to design this numerical experiment and will be presented at this seminar.

Serdecznie zapraszamy,
M. Dąbrowski, T. Kwiatkowski