Unsteady RANS and LES Analyses of Hooper?s Hydraulics Experiment in a Tight Lattice Bare Rod-bundle

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Several experiments have already reported the existence of flow oscillations in a tight lattice bare rod-bundle. This in-turn results in temperature oscillations, when heat transfer is also involved. Consequently, assessment of flow oscillations plays an important role in the design of future innovative reactor systems as proposed by the Generation IV International Forum. Literature review reveals that such flow oscillations have recently numerically been analyzed using Unsteady Reynolds Averaged Navier-Stokes (URANS) and Large Eddy Simulation (LES) techniques.
The objective is to assess URANS and LES turbulence modelling techniques for application in tight rod bundles to determine:

- temperature oscillations arising from flow oscillations in a tight lattice rod bundle
- occurrence of flow induced vibrations

To this purpose, as a first step this paper will present URANS and LES analyses of the hydraulics experiment performed by Hooper in a tight lattice bare rod-bundle (pitch-to-diameter ratio is 1.107). These simulations are performed using STAR-CCM+. The numerical analyses reveal the existence of flow oscillation as observed in the experiment. This is concluded from the analyzed instantaneous velocities at a plane and the time dependent velocities at a point in the computational domain. As expected, for a given grid and time step, these results show that the employed LES approach resolves smaller structures compared to the employed URANS approach. The influence of the flow on the surface of the rods is assessed by analyzing the wall shear stress magnitude and its power spectra.

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[1] http://www.cd-adapco.com/sites/default/files/Presentation/2010-NUTHOS8-Chandra_URANS%20%26%20LES%20approaches.pdf