Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Large-eddy simulation of turbulent flows around a fin-tube heat exchanger enclosed by a compartment CHANGKEUN SON, Dept. Mech. Eng., Sogang Univ., Seoul, South Korea, SIMON SONG, JEESOO LEE, Dept. Mech. Convergence Eng., Hanyang Univ., Seoul, South Korea, SEONGWON KANG, Dept. Mech. Eng., Sogang Univ., Seoul, South Korea — The main objective of the present study is to analyze heat transfer and flow characteristics of a heat exchanger in an industrial application using high-fidelity simulation techniques. Large-eddy simulations (LES) were performed to investigate the turbulent flows around a fin-tube heat exchanger enclosed by a compartment. The complex geometry of the compartment poses a difficulty in a simulation as the local Re number is about two orders of different magnitude, and generates various scales of the 3-D vortices and complex flow patterns. Careful tests with both grid resolution and turbulent inflow boundary condition were performed in order to compare our results to the measured data from a MRV experiment as well as the results from RANS simulations. From interaction of the flow structures such as the 3-D vortices, a few interesting flow phenomena were observed which are different from a plain fin-tube heat exchanger, such as helical flows and a jet stream observed behind the fin-tube region. Also, performance of the heat exchanger was analyzed using the data from plain fin-tube heat exchangers. Based on this analysis, a numerical technique for heat exchanger was devised and tested to show a possibility of reducing the computational cost significantly, using a porous media model.

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Date submitted: 24 Jul 2014 Electronic form version 1.4