Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Impact of Model Fidelity on Jet Impingement Simulations BENJAMIN REIBMAN, MIKE BENSON, United States Military Academy, DAVID HELMER, GREGORY RODEBAUGH, GE — Turbulence modeling in the RANS framework has difficulty properly capturing free jet impingement, as both the shear layer of the jet upon entrance to the free stream and the impingement onto the flat plate are complex turbulent situations. In an effort to assess the accuracy of different turbulence modeling approaches and quantify fidelity/computational cost tradeoffs, a case study was conducted using the experimental data of Cooper et al 1993. This study consisted of both RANS and LES modeling. RANS analysis was conducted over a sweep of case conditions (z/D = 2, 6 and Re = 23000, 70000) leveraging multiple commercial solvers and a variety of common two-equation turbulence models. A grid refinement study was conducted with both structured and unstructured meshes to determine grid and solver dependence. The predictive capability of DDES in addition to WALE and dynamic one-equations k LES SGS closures for the z/D = 2 Re = 23000 case were compared against RANS and experimental data. The experimental data consisting of Nusselt numbers over radial diameters, pipe flow bulk velocity and wall jet velocity were the principal means of determining accuracy of the various models. This study will provide an assessment of the impact of the use of lower fidelity models in future analysis involving more complex geometries. This will provide guidance on the required fidelity at each stage of the design process in multiple fields utilizing impinging jets.

Benjamin Reibman
United States Military Academy

Date submitted: 01 Aug 2013 Electronic form version 1.4