Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Assesment of turbulence models for boundary layers with pressure gradient and roughness RABIJIT DUTTA, UGO PIOMELLI, Queens University — The performance of sand-grain-based roughness corrections for the SA, SST $k-\omega$ and $k-\epsilon$ models has been evaluated by comparing the model results with large eddy simulation (LES) data. Computations are performed for a turbulent boundary layer with both smooth and rough walls subjected to two different pressure-gradient conditions, namely, an adverse pressure gradient (APG) with separation and a realistic pressure-gradient situation encountered in a hydraulic turbine blade. A new roughness correction was developed for the SST $k-\omega$ model that gave improved results near separation. For the cases with smooth wall, RANS models give reasonable agreement in predicting skin friction coefficient (c_f) at the wall. RANS models predict too high Reynolds stresses in the separated region, which lead to earlier reattachment. For the rough wall computations, the RANS models predict that c_f changes sign much later than the LES data. In the LES, however, the wall stress becomes negative inside the roughness sublayer, and the flow reversal does not correspond to the separation, which occurs much later, where the separation leaves the body, and the total stress above the roughness crest changes sign. The RANS models predict the position of this point more accurately.

Rabijit Dutta
Queens University

Date submitted: 01 Aug 2015 Electronic form version 1.4