Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

On the behavior of two-equation turbulence models in the limit of low turbulence levels: A dynamical systems approach B. ANDERS PETTERSSON REIF, Norwegian Defence Research Establishment (FFI), CHRIS RUMSEY, THOMAS GATSKI, NASA Langley Research Center — The utilization of the Reynolds-averaged Navier-Stokes (RANS) approach continues to dominate computational predictions of turbulent flows in a wide range of disciplines. Despite the simplistic statistical treatment of the turbulence motion, RANS prevails as the primary computational tool in the vast majority of applications. The present study is motivated by the challenges posed in conjunction with computing transitional flows, in particular by the need to better understand the response of models that routinely are applied in complex turbulent flow computations where regions of very low turbulence levels exist. A dynamical systems analysis is employed in this study to shed light on the dynamical behavior of the most commonly used two-equation models, and to aid the identification of inherent limitations that may have practical consequences. It is demonstrated that some common forms of the K-e model can yield arbitrary steady state solutions in transitional flows that depend on numerical solution parameters such as initial conditions and solution methodologies. In particular models that utilizes a wall damping coefficient in the destruction term of the dissipation rate transport equation. A so-called null-cline analysis will be introduced as a useful tool to analyze the solution of models equations near critical points.

B. Anders Pettersson Reif
Norwegian Defence Research Establishment (FFI)

Date submitted: 12 Aug 2005 Electronic form version 1.4