

Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Assessing the Impacts of Low Level Jets over Wind Turbines¹

WALTER GUTIERREZ RODRIGUEZ, Department of Mechanical Engineering, Texas Tech University, Lubbock, TX, GUILLERMO ARAYA, Mechanical Engineering Department, University of Puerto Rico, Mayaguez, ARQUIMEDES RUIZ-COLUMBIE, National Wind Institute, Texas Tech University, Lubbock, TX, MURAT TUTKUN², Institute for Energy Technology (IFE), Kjeller, Norway, LUCIANO CASTILLO, Department of Mechanical Engineering, Texas Tech University, Lubbock, TX — Low Level Jets (LLJs) are defined as regions of relatively strong winds in the lower part of the atmosphere. They are a common feature over the Great Plains in the United States. This paper is focused on the determination of the static/dynamic impacts that real LLJs in West Texas have over wind turbines and wind farms. High-frequency (50Hz) observational data from the 200-m meteorological tower (Reese, Texas) have been input as inflow conditions into the NREL FAST code in order to evaluate the LLJ's structural impacts on a typical wind turbine. Then, the effect of the LLJ on the wind turbine's wake is considered to evaluate the overall impact on the wind farm. It has been observed that during a LLJ event the levels of turbulence intensity and turbulence kinetic energy are significantly much lower than those during unstable conditions. Also, low-frequency oscillations prevail during stable conditions when LLJs are present, as opposed to high-frequency oscillations which are more prevalent during unstable conditions. Additionally, in LLJs the energy concentrates in particular frequencies that stress the turbine whereas turbine signals show frequencies that are also present in the incoming wind.

¹Grants: NSF-CBET #1157246, NSF-CMMI #1100948, NSF-PIRE # NSF-OISE-1243482.

²University of Oslo, Department of Mathematics, Oslo, Norway

Walter Gutierrez Rodriguez
Department of Mechanical Engineering, Texas Tech University, Lubbock, TX