Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

**Fundamental Distinctions in Physics underlying Nonsteady Forcings of Wind Turbine Power vs. Drivetrain by Atmospheric Turbulence**

JAMES BRASSEUR, U Colorado, ADAM LAVELY, TARAK NANDI, Penn State

— Whereas the primary function of a wind turbine (WT) is the generation of electricity, wind farm profitability is decreased both by integrated losses in power and increases in premature failures of drivetrain components resulting from energetic nonsteady aerodynamic forcings of WT rotors by atmospheric and wake turbulence. Here we contrast the physics underlying dominant nonsteady atmospheric turbulence forcings of the bending moments in the WT rotor plane (torque/power) vs. the out-of-plane bending moments (OPBM) that underlie premature drivetrain component failure. Using an advanced actuator line model of the 5 MW NREL and the 1.5 MW GE wind turbine rotors embedded within a high-fidelity spectral LES of a typical daytime convective atmospheric boundary layer, we show that (1) the physics underlying large torque vs. OBPM fluctuations are associated with fundamentally different turbulence eddy characteristics and (2) nonsteady response centers on 4 characteristic time scales associated advection of eddies and load response of blades cutting through internal turbulence eddy structure. *Supported by DOE. Computer resources by NSF/XSEDE.*

James Brasseur
U Colorado

Date submitted: 31 Jul 2016 Electronic form version 1.4