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DAMAGE ESTIMATES FROM LONG-TERM STRUCTURAL ANALYSIS OF A WIND TURBINE IN A U.S. WIND FARM ENVIRONMENT[*†]

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Abstract[1][2]

Time-domain simulations of the loads on wind energy conversion systems have been hampered in the past by the relatively long computational times for nonlinear structural analysis codes. However, recent advances in both the level of sophistication and computational efficiency of available computer hardware and the codes themselves now permit long-term simulations to be conducted in reasonable times. Thus, these codes provide a unique capability to evaluate the spectral content of the fatigue loads on a turbine. To demonstrate these capabilities, a Micon 65/13 turbine is analyzed using the YawDyn and the ADAMS dynamic analysis codes. The SNLWIND 3-D simulator and measured boundary conditions are used to simulate the inflow environment that can be expected during a single, 24-hour period by a turbine residing in Row 41 of a wind farm located in San Gorgonio Pass, California. Also, long-term simulations (up to 8 hours of simulated time) with constant average inflow velocities are used to better define the characteristics of the fatigue load on the turbine. Damage calculations, using the LIFE2 fatigue analysis code and the MSU/DOE fatigue data base for composite materials, are then used to determine minimum simulation times for consistent estimates of service lifetimes.

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