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PREDICTING DESIGN WIND TURBINE LOADS FROM LIMITED DATA: COMPARING RANDOM PROCESS AND RANDOM PEAK MODELS

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Abstract

This paper considers two distinct topics that arise in reliability-based wind turbine design. First, it illustrates how general probability models can be used to predict long-term design loads from a set of limited-duration, short-term load histories. Second, it considers in detail the precise choice of probability model to be adopted, for both flap and edge bending loads in both parked and operating turbine conditions. In particular, a 3-moment random peak model and a 3- or 4-moment random process model are applied and compared. For a parked turbine, all models are found to be virtually unbiased and to notably reduce uncertainty in estimating extreme loads (e.g., by roughly 50 percent). For an operating turbine, however, only the random peak model is found to retain these beneficial features. This suggests the advantage of the random peak model, which appears to capture the rotating blade behavior sufficiently well to accurately predict extremes.