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ALL WIND FARM UNCERTAINTY IS NOT THE SAME: THE ECONOMICS OF COMMON VERSUS INDEPENDENT CAUSES*

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ABSTRACT

There is uncertainty in the performance of wind energy installations due to unknowns in the local wind environment, machine response to the environment, and the durability of materials. Some of the unknowns are inherently independent from machine to machine while other uncertainties are common to the entire fleet equally. The FAROW computer software for fatigue and reliability of wind turbines is used to calculate the probability of component failure due to a combination of all sources of uncertainty. Although the total probability of component failure due to all effects is sometimes interpreted as the percentage of components likely to fail, this perception is often far from correct. Different amounts of common versus independent uncertainty are reflected in economic risk due to either high probabilities that a small percentage of the fleet will experience problems or low probabilities that the entire fleet will have problems. The average, or expected cost is the same as would be calculated by combining all sources of uncertainty, but the risk to the fleet may be quite different in nature. Present values of replacement costs are compared for two examples reflecting different stages in the design and development process. Results emphasize that an engineering effort to test and evaluate the design assumptions is necessary to advance a design from the high uncertainty of the conceptual stages to the lower uncertainty of a well engineered and tested machine.

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