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MODAL TESTING IN THE DESIGN EVALUATION OF WIND TURBINES

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ABSTRACT

In the design of large, flexible wind turbines subjected to dynamic loads, knowledge of the modal frequencies and mode shapes is essential in predicting structural response and fatigue life. During design, analytical models must be depended upon for estimating modal parameters. When turbine hardware becomes available for testing, actual modal parameters can be measured and used to update the analytical predictions or modify the model. The modified model can then be used to reevaluate the adequacy of the structural design. Because of problems in providing low-frequency excitation (0.1 to 5.0 Hz), modal testing of large turbines can be difficult. This report reviews several techniques of low-frequency excitation used successfully to measure modal parameters for wind turbines, including impact, wind, step-relaxation, and human input. As one application of these techniques, a prototype turbine was tested and two modal frequencies were found to be close to integral multiples of the operating speed, which caused a resonant condition. The design was modified to shift these frequencies, and the turbine was retested to confirm expected changes in modal frequencies.

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