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PARAMETRIC STUDY FOR LARGE WIND TURBINE BLADES

WindPACT Blade System Design Studies

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Abstract

This report presents the results of a study of various wind turbine blade design parameters as a function of blade length in the range from 30 meters to 70 meters. The results have been summarized in dimensional and non-dimensional formats to aid in interpretation. The parametric review estimated peak power and annual energy capture for megawatt scale wind turbines with rotors of 62, 83, 104, 125, and 146 meters in diameter. The baseline "thin" distribution represents conventional airfoils used in large wind turbine blades. The "thicker" and "thickest" distributions utilize airfoils that have significantly increased thickness to improve structural performance and reduce weight. An aerodynamic scaling effort was undertaken in parallel with the structural analysis work to evaluate the effect of extreme thickness on aerodynamic characteristics. Increased airfoil section thickness appears to be a key tool in limiting blade weight and cost growth with scale. Thickened and truncated trailing edges in the inboard region provide strong, positive effects on blade structural performance. Larger blades may require higher tip speeds combined with reduced blade solidity to limit growth of design loads. A slender blade can be used to reduce extreme design loads when the rotor is parked, but requires a higher tip speed.