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Blade System Design Studies Volume II: Preliminary Blade Designs and Recommended Test Matrix

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Abstract

As part of the U.S. Department of Energy's Wind Partnerships for Advanced Component Technologies (WindPACT) program, Global Energy Concepts, LLC is performing a Blade System Design Study (BSDS) concerning innovations in materials, processes and structural configurations for application to wind turbine blades in the multi-megawatt range. The BSDS Volume I project report addresses issues and constraints identified to scaling conventional blade designs to the megawatt size range, and evaluated candidate materials, manufacturing and design innovations for overcoming and improving large blade economics. The current report (Volume II), presents additional discussion of materials and manufacturing issues for large blades, including a summary of current trends in commercial blade manufacturing. Specifications are then developed to guide the preliminary design of MW-scale blades. Using preliminary design calculations for a 3.0 MW blade, parametric analyses are performed to quantify the potential benefits in stiffness and decreased gravity loading by replacement of a baseline fiberglass spar with carbon-fiberglass hybrid material. Complete preliminary designs are then presented for 3.0 MW and 5.0 MW blades that incorporate fiberglass-to-carbon transitions at mid-span. Based on analysis of these designs, technical issues are identified and discussed. Finally, recommendations are made for composites testing under Part II of the BSDS, and the initial planned test matrix for that program is presented.