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Challenges and Opportunities in Large Offshore Rotor Development: Sandia 100-meter Blade Research

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Sandia National Laboratories' (SNL) Wind & Water Power Technologies Department, as part of its ongoing R&D efforts, creates and evaluates innovative large blade concepts for horizontal axis wind turbines to promote designs that are more efficient aerodynamically, structurally, and economically. Recent work has focused on the development of a 100-meter blade for a 13.2 MW horizontal axis wind turbine, a blade that is significantly longer than the largest commercial blades of today and is targeted for offshore rotors. This paper summarizes the design and development of the Sandia 100-meter All-glass Baseline Wind Turbine Blade, termed as "SNL100-00". This model employs conventional architecture and fiberglass-only composite materials to arrive at a working baseline model of 100-meter length with conventional design constraints. A certification-like design process was followed for the design of the baseline SNL100-00 blade. The resulting performance margins for a suite of analyses along with new trends in design drivers are reported. The SNL100-00 design model was made publicly available in June 2011 for use by other researchers and internal blade studies at Sandia. The paper also includes initial parameter studies to apply innovations to SNL100-00 that target reductions in weight. The focus is material selection and usage with deployment of carbon fiber into the all-glass baseline. The results of these studies include quantification of weight reduction while observing tradeoffs in performance margins for the principal new large blade design drivers, including buckling, gravitational fatigue loading, and aeroelastic stability. This study will ultimately culminate in dissemination of an updated design model (e.g. "SNL100-01") that incorporates carbon fiber for a large blade in an effective way.

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