Fatigue Testing of 9 m Carbon Fiber Wind Turbine Research Blades*

Joshua Paquette†
Sandia National Laboratories‡, Albuquerque, NM, 87185

Jeroen van Dam§ and Scott Hughes§
*National Renewable Energy Laboratory**, Golden, CO, 80401*

Jay Johnson
Georgia Institute of Technology, Atlanta, GA, 30318

Fatigue testing was conducted on Carbon Experimental and Twist-Bend Experimental (CX-100 and TX-100) 9-m wind turbine research blades. The CX-100 blade was designed to investigate the use of a carbon spar cap to reduce weight and increase stiffness while being incorporated using conventional manufacturing techniques. The TX-100 blade used carbon in the outboard portion of the skin to produce twist-bend coupling to passively alleviate aerodynamic loads. In the fatigue tests, the CX-100 blade was loaded by a single hydraulic cylinder while the TX-100 blade was loaded via a hydraulically-actuated resonant loading system called the Universal Resonant Exciter. The blades were outfitted with approximately 30 strain gages as well as displacement and load sensors. Both blades survived to cycle counts sufficient to demonstrate a 20-year operational life. The CX-100 blade failed at approximately 1.6 million cycles because of a buckle and crack that formed and grew just outboard of max-chord. The TX-100 blade failed because of a crack that grew from the termination point of the spar cap at the midspan of the blade. This paper covers the results of the fatigue tests.

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§ National Wind Technology Center, MS3911
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†† Global Energy Concepts, LLC, 5729 Lakeview Drive NE, Suite 100, Kirkland, WA 98033-7340, (425) 822-9008
‡‡ MDZ Consulting, 601 Clear Lake Road, Clear Lake Shores, Texas 77565, (281) 334-5681