Experimental Results of Structural Health Monitoring of Wind Turbine Blades*

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A 9 meter TX-100 wind turbine blade, developed under a Sandia National Laboratories R&D program, was recently fatigue tested to blade failure at the National Renewable Energy Laboratories, National Wind Technology Center. The fatigue test provided an opportunity to exercise a number of structural health monitoring (SHM) techniques and nondestructive testing (NDT) systems. The SHM systems were provided by teams from NASA Kennedy Space Center, Purdue University and Virginia Tech (VT). The NASA and VT impedance-based SHM systems used separate but similar arrays of Smart Material macro-fiber composite actuators and sensors. Their actuator activation techniques were different. The Purdue SHM setup consisted of several arrays of PCB accelerometers and exercised a variety of passive and active SHM techniques, including virtual and restoring force methods. A commercial off-the-shelf Physical Acoustics Corporation acoustic emission (AE) NDT system gathered blade AE data throughout the test. At a fatigue cycle rate around 1.2 Hertz, and after more than 4,000,000 fatigue cycles, the blade was diagnostically and visibly failing at the blade spar cap termination point at 4.5 meters. For safety reasons, the test was stopped just before the blade completely failed. This paper provides an overview of the SHM and NDT system setups, and some test results.

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