CONDITION MONITORING OF WIND TURBINE BLADE CRACK PROGRESSION DURING A FATIGUE TEST USING ACOUSTIC EMISSION

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Abstract text

Within the wind energy industry improvements in wind turbine maintenance strategies are demanded through the use of condition monitoring systems. The wind turbine blades are critical components and in this study is the focus point.

A laboratory study is reported of fatigue damage growth monitoring in a 45.7m long wind turbine blade. The main purpose of this study was to investigate the feasibility of in-service monitoring of the structural health of blades by acoustic emission. Cyclic loading by compact resonant masses was performed to accurately simulate in-service load conditions and 187kcs of fatigue were performed over periods which totalled 21 days, during which acoustic emission monitoring was performed in a selected area with a 4 sensor array. In addition strain monitoring took place with an array of 30 sensors evenly distributed over the blade and also the shifts of frequencies of natural vibration modes were investigated a function of the presence of defects. A simulated rectangular defect of dimensions 1000mm x 50mm x 10mm was introduced into the blade material. A high detection threshold was employed to suppress acoustic emission noise generated by the fatigue loading, which was a realistic simulation of the noise that would be generated in service from wind impact and acoustic coupling to the tower and nacelle.

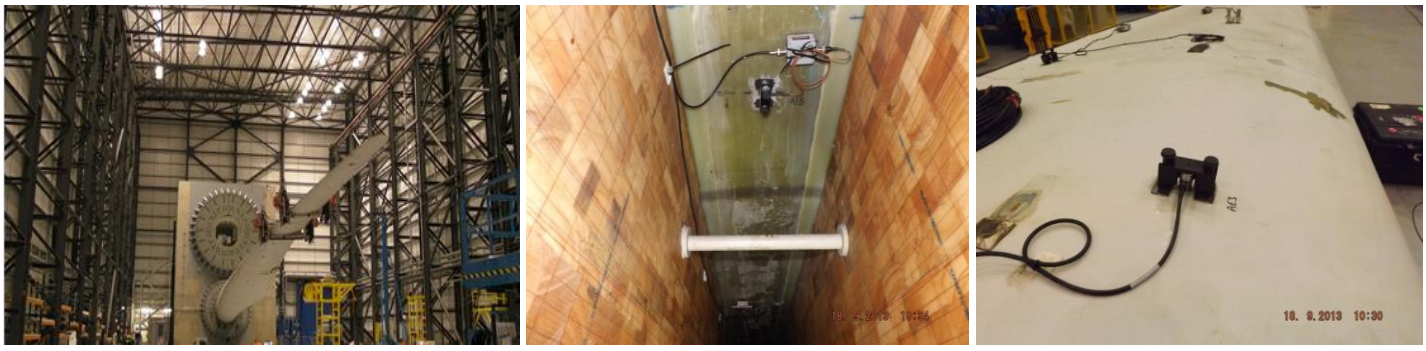

Figure1. Wind turbine blade under test and AE sensors deployment

The damage detection signals were successfully discriminated from noise by time of flight signal correlation. This process thus rejected much of noise peaks rising above the detection threshold. In view of the small scale of the damage growth relative to the blade size that was successfully detected, the developed acoustic emission monitoring methodology shows excellent promise as an in- service blade integrity monitoring technique capable of providing early warnings of developing damage before it becomes too expensive to repair.

Keywords: Acoustic Emission, Blade, Fatigue, Structural Health Monitoring, Wind Turbine