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## **DAMAGE ESTIMATES FOR EUROPEAN AND U.S. SITES USING THE U.S. HIGH-CYCLE FATIGUE DATA BASE**

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### **ABSTRACT**

This paper uses two high-cycle fatigue data bases, one for typical U.S. blade materials and one for European materials, to analyze the service lifetime of a wind turbine blade subjected to the WISPER load spectrum for northern European sites [Ten Have, 1992] and the WISPER protocol load spectrum for U.S. wind farm sites [Kelley, 1995]. The U.S. data base, developed by Mandell, et al. (1995), contains over 2200 data points that were obtained using coupon testing procedures. These data are used to construct a Goodman diagram that is suitable for analyzing wind turbine blades. This result is compared to the Goodman diagram derived from the European fatigue data base FACT [DeSmet and Bach, 1994]. The LIFE2 fatigue analysis code for wind turbines [Sutherland and Schluter, 1989] is then used to predict the service lifetime of a turbine blade subjected to the two loading histories. The results of this study indicate that the WISPER load spectrum from northern European sites significantly underestimates the WISPER protocol load spectrum from a U.S. wind farm site; i.e., the WISPER load spectrum significantly underestimates the number and magnitude of the loads observed at a U.S. wind farm site. Further, the analyses demonstrate that the European and the U.S. fatigue material data bases are in general agreement for the prediction of tensile failures. However, for compressive failures, the two data bases are significantly different, with the U.S. data base predicting significantly shorter service lifetimes than the European data base.