

Modal Testing of Wind Turbines

Case Study

OVERVIEW

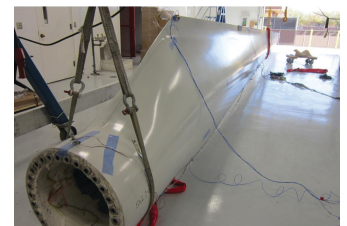
Sandia National Laboratories (SNL), in partnership with the U.S. Department of Energy and Texas Tech University, constructed the Scaled Wind Farm Technology (SWiFT) facility in Lubbock, Texas. SNL developed SWiFT to enable rapid, cost-efficient testing and development of transformative wind energy technology. As part of this effort, ATA Engineering, Inc., (ATA) was contracted by SNL to perform modal testing on several components of the Vestas V27 wind turbines as well as two fully assembled V27 turbines to gain a better understanding of the structures. Test data was used for updating and correlating aeroelastic models to provide an accurate simulation capability.

TASKS PERFORMED & KEY OUTCOMES

- Modal testing on blades, hubs, nacelles, and towers, with results used to update the finite element models.
- Testing of the tower in both free-free and fixed-free boundary conditions to better understand the dynamic characteristics of the tower bolted to the concrete foundation.
- Mass property testing of the blades, hubs, and nacelles performed using a traditional bifilar and load cell approach, with advanced mass property extraction from dynamic testing.
- Artificial and ambient excitation modal testing of two fully assembled wind turbines, with results compared between the two excitation techniques and used to verify the accuracy of the system models.
- Design and analysis of test fixtures to support the 13-ton wind turbine towers in a free-free boundary condition.



Full turbines were tested to obtain frequencies for model comparison



Individual blades were tested to determine variance between blades



Nacelles and hubs were tested to determine mass and inertia