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DOE/SNL Scaled Wind Farm Technology Facility at Texas Tech University

By the end of FY12 the US Department of Energy and Sandia National Laboratories will have completed the development of the Scaled WInd Farm Technology (SWIFT) Facility, hosted at Texas Tech University, to enable rapid, cost-efficient testing and development of transformative wind energy technology. The primary objectives of SWIFT will be to: (1) reduce power-losses and damage caused by turbine-turbine interaction shown in Figure 1, (2) enhance energy capture and damage mitigation potential of advanced rotors, and (3) improve the validity of aerodynamic, aero-elastic and aero-acoustic simulations used to develop innovative technologies. SWIFT is intended to perform at the highest quality of accredited research testing for both collaborative and highly proprietary projects with industrial, governmental and academic partners.

SWIFT will initially consist of two research-scale wind turbines (heavily modified Vestas V27's) in a direct upwind-downwind placement with a four rotor-diameter spacing between, as shown in Figure 2, and the potential to add seven additional research-scale wind turbines in the future. The V27 turbine was chosen as the test bed due to its proven history of high reliability. It will be capable of full variable-speed variable-pitch operation with rotational speeds ranging from 0 to 55 rpm, rotor blades of 9 to 15 meter length, and a maximum power rating of 300 kW. These research-scale machines have a Reynolds Number of $2x10^6$ and maximum tip-speeds of 80 meters per second which is intended to make the results directly scalable to much larger turbines. In comparison to larger production turbines, at the research-scale, blades and molds are approximately 5% of the cost, cranes are 2% of the cost, crane scheduling is reduced from months-ahead to days-ahead, and failure risk is substantially less.

The turbines will be heavily instrumented with state-of-the-art control and data acquisition systems featuring site-wide time synchronization based on GPS. The site instrumentation will provide hundreds of channels of structural and aerodynamic data to fully estimate the instantaneous state of the rotor, wind turbines and wind farm for advanced control strategies, such as rotor-based active aerodynamic load control. In addition, a 60 meter anemometer tower will be located 2 rotor diameters directly upwind of the turbine that will have research-grade three-dimensional sonic anemometers to measure the inflow at six levels, including one that is a blade length above the rotor.

Additional facilities at the site include the Texas Tech University 200 meter anemometer tower (http://www.depts.ttu.edu/weweb/TheCenter/Facilities/Research%20Facilities/200mTower.php), a control building that includes temporary office space for proprietary research, and an assembly building with approximately 6,000 sq. ft. of high-bay work space for experimental preparation, as shown in Figure 3.

For additional information contact Jon White at jonwhit@sandia.gov.

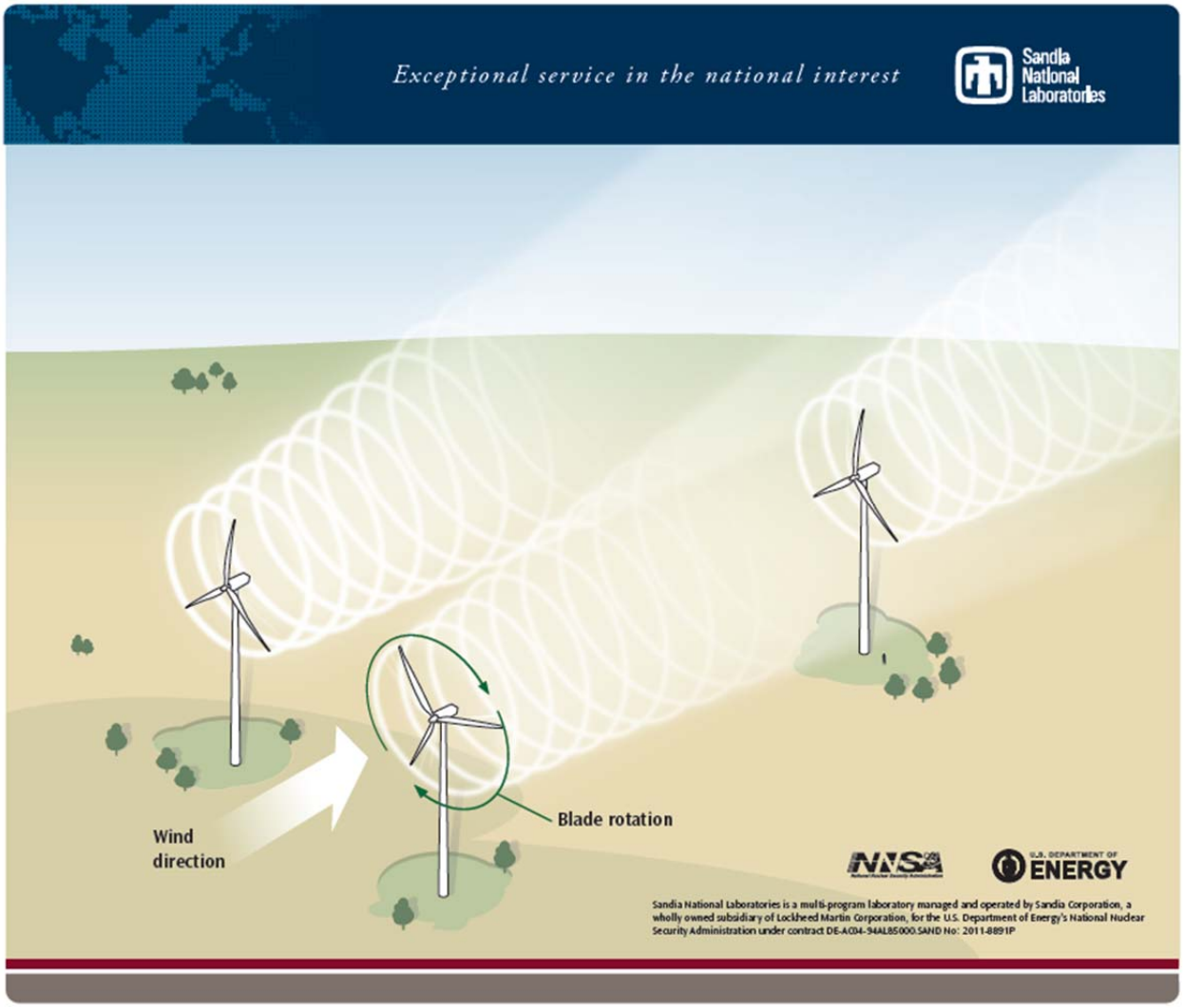

Figure 1 Turbine-turbine interaction schematic with wakes denoted by white helices and white fog.

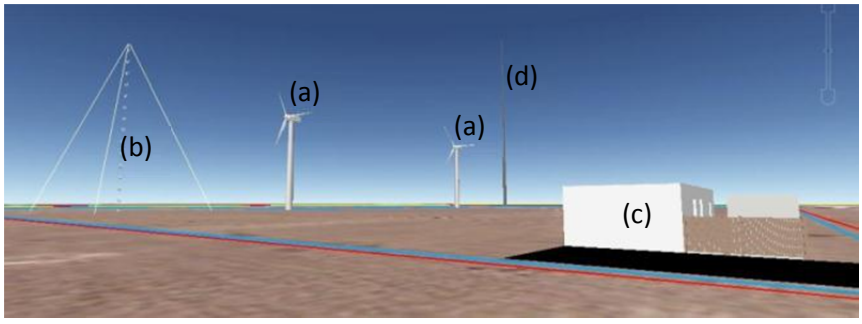

Figure 2 SWIFT proposed layout with (a) two research-scale wind turbines, a heavily instrumented (b) 60 meter anemometer tower, and (c) a control building. (d) Texas Tech University 200 meter anemometer tower already in operation.

Figure 3 Re-purposed assembly building