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NREL's SOWFA WIND FARM SIMULATION SOFTWARE OFFERS HOLISTIC VIEW OF ALL TURBINES ON A WIND FARM

By Bill Scanlon
National Renewable Energy Laboratory

Wind energy is blowing away skeptics — it's so close to achieving cost parity with fossil fuels that just a little extra efficiency is all that is likely needed to push it into the mainstream and past the Energy Department's goal of 20 percent wind energy by 2030.

That extra efficiency may be realized with the help of a software tool built by the Energy Department's National Renewable Energy Laboratory. It's called Simulator for Wind Farm Applications (SOWFA), and it can calculate how undulating ground, whipping blades, surface temperatures, and other variables alter the air flow and energy production at wind farms.

SOWFA's key innovation is that it simulates an extensive range of scales — from regional weather patterns down to the space between turbines and all the way to the movement of electrons. It gives a complete picture of an active plant, showing how controlling each turbine can influence the direction of the wakes, and detecting the effect on downwind turbines. It helps researchers understand how local atmospheric conditions affect local wind around the wind farm. SOWFA is the first tool that enables developers to improve the performance of not only one wind turbine, but the entire wind farm. Because it is an open-source "community" software platform available for free to academics, investors, wind developers, and manufacturers, users have the support of an online forum where they can discuss problems and solutions with other SOWFA users.

One application of SOWFA is the simulation and design of coordinat-

ed control of individual turbines in order to maximize plant-wide output. Using these controllers, upstream turbines can yaw their rotors to redirect their wakes away from downstream turbines, substantially improving power capture. Wake losses at wind farms can reduce total power production by 10 percent. If SOWFA can be used to design controllers that cut those losses in half, that's a huge benefit. If employed at wind farms across the country and the world, the additional revenue could add up to billions of dollars.

SOWFA SIMULATES WAKE EFFECT FOR TURBINES DOWNWIND

Across the Great Plains and at many spots offshore, if you see one wind turbine, you're likely to see a dozen or a hundred. A wind farm provides economies of scale—contract with a farmer or win a permit for offshore wind, and it makes sense to erect multiple turbines all tied to a single system.

However, those rows of giant turbines can be problematic. As the turbine's blades are turned by the wind, they also disrupt the wind, causing a wake similar to a calm spot behind a tree or building. If that wake heads straight for the next turbine downstream — maybe 800 meters away — its churn will mean weaker wind and less power produced by that second turbine.

But SOWFA shows turbine manufacturers, wind farm developers, or investors how a yaw can impart a thrust that curves that wake around the downwind turbine. "Wake, from a power perspective, is lower-energy wind," said NREL Senior Engineer Paul Fleming, one of the engineers using SOWFA in his research. "If you can move away that deficit of energy, you will have faster winds and more overall production at the wind farm."

"In the past, wind farms have relied on dissipation to control that energy loss—they just move the turbines farther away from each other," said NREL senior engineer Pat Moriarty, a leader of the SOWFA team. "Now, we can control it in a different way. And there are other ways to achieve more control."

SOWFA was created to model all the different variables at a wind farm — the topography, the air, surface and air temperatures, even the effects of the turbines themselves. Other models have looked at pieces of the whole, but now that the wind industry is maturing and the cost margins are decreasing, it's increasingly important to model the whole system and maximize energy production.

TURBINES AND CENTRAL CONTROLLER TALK TO EACH OTHER

With SOWFA, the central super-controller can receive information from individual turbines and send command messages to them. In other words, the central controller and the turbines can talk to each other. SOWFA's central controller can send a message asking a turbine to adjust its yaw — but the turbine can override that command if conditions at the turbine are such that adjusting the yaw would be unsafe. This architecture is designed to mimic as closely as possible how wind plant controls might be implemented at a real wind farm.

Another reason SOWFA is unique among wind modeling tools is that it has the capacity to incorporate the heat on the earth's surface into its calculations. The sun is the main reason that air moves. It causes different air temperatures and pressures, coaxing the wind in a particular direction at a particular speed and at different heights above the ground. The varying temperature of the ground and the hills and vales of the farm also influence how the wind moves through the atmosphere. In the daytime, when the ground is hot, the wind tends to be more turbulent, rising from the surface.

At night, when the ground is cooler than the air, the wind becomes more horizontal and speeds up. The same rules apply offshore, except instead of the ground there is the water surface, and instead of hills and vales, there are the size and motion of the waves.

The software tool also can deliver the numbers to show a possible overall net benefit if that first row of turbines reduces the capture of wind so the second row can capture more.

REDUCING UNCERTAINTY CAN LOWER FINANCIAL RISK, INTEREST RATES

SOWFA has drawn acute interest from manufacturers, developers, and utilities. "One of the most important outputs of SOWFA is the reduced uncertainty," Moriarty said. "The finance community cares not just about energy production, but about the uncertainty of energy production over the next 20 years that wind farm would be operating. They particularly want to know what the worst-case energy production can be."

SOWFA's improved look at physics will help the community better understand the uncertainty gap between the average energy production and the worst-case energy production. That, in turn, should lower the interest rates for financing a wind farm, which can be a huge part of the total cost.

For more information, visit www.nrel.gov.

Janicki Industries

Washington-based composites firm has been leading the innovation charge for large-scale, high-precision CNC milling for more than two decades

By Stephen Sisk

At the heart of innovation lies the search for improvement — a better, faster, more efficient way. A less expensive way.

In 1993, Peter Janicki, an engineer, and Founder and CEO of Janicki Machine Design answered innovation's call and revolutionized composites fabrication for the marine manufacturing industry.

The traditional method of producing molds for the fabrication of composite materials was expensive, time consuming, and labor intensive. Janicki had a better way — an innovation.

He developed a method of producing the molds by utilizing large-scale, high-precision CNC machining. The results were beyond impressive. When introduced, Janicki's innovation — now commonplace in the industry — resulted in less expensive molds that could be produced in a fraction of the time required with traditional methods. Projects that once took several months to finish were being completed in two weeks or less.

In the two decades since his pioneering efforts, the company he founded, now known as Janicki Industries, continues to place innovation — research and development — at the center of its business philosophy.

Headquartered in Sedro-Woolley, Washington, near the halfway point between Seattle and Vancouver, Janicki Industries has diversified into other industries which rely heavily on composites fabrication — aerospace, wind energy, defense, and transportation, among others.

"We're a privately owned, full-service engineering and manufacturing company specializing in making products from advanced composite materials with a unique claim of large parts, because we have high-precision CNC mills that are among the largest in the world," said Steven Lynn, marketing director for Janicki Industries.

That large-scale capability is the primary factor that sets the company apart from others in the industry, he said. "We are the large-scale, high-precision producers. We can make things the size of a conference room table, but so can a million other machine shops. If a customer wants something 100 or 200 feet long, and they want it made to within .003" for it's unique size, we're the unique company to provide that for them."

That capability is necessary for applications in the wind energy industry, which Janicki is able to serve primarily in the production of wind turbine rotor blades, as well as in the design

and manufacture of the molds used in blade fabrication.

The company now operates a total of nine large-scale, high-precision 5-axis CNC mills at three manufacturing/production centers in Washington State and Utah.

In Washington, two facilities — located in Sedro-Woolley and Hamilton — boast nearly 290,000 square feet of production capacity in five buildings. Combined, the two facilities encompass 116 acres. The Washington sites house six of the CNC mills, with envelope sizes up to 100 feet by 20 feet by 8 feet, making them among the largest in the world.

Located by Hill Air Force Base, the Utah facility is equipped with three CNC mills, measuring up to 80 feet by 14 feet by 6 feet. At 100,000 square-feet, this facility is optimized for producing large-scale parts at a high volume.

Janicki's facilities also house other composites manufacturing assets, including ovens, autoclaves, and furnaces, as well as on-site shops for machining, painting, curing, and welding.

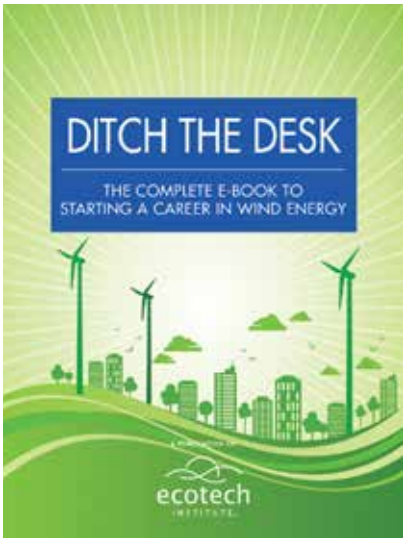
However, the company's work doesn't just take place on the production room floor. Aligning both with its engineering foundation and commitment to innovation, the company employs unique methods of project management and customer co-development that allows project status visibility for both parties throughout all stages of a project.

"We tell our customers to 'bring us your challenges.' We have over 600 employees, of which about 130 are engineers, 20 percent have advanced degrees," Lynn said. "Some companies don't understand composites yet. Our guys do. They've been designing with them for twenty years. We work together with our customers to design their solution and help them figure out what material to use, and then we go ahead and build it for them. We help them with their solution."

Janicki's project management paradigm, centered around an enterprise solution from SAP, allows the company ultimately to predict project completion status and delivery date with a high degree of reliability — 90 percent or above.

"That allows us to project or forecast our revenue and costs but it also allows our customers to do the same thing," Lynn said. "What our customers like about us that is a little bit unique is that we do have a project manager in charge of every project for a customer and that we give that customer full visibility and we know and keep up-to-date the schedule of activities going on, so that everybody can have accurate forecasts.

Ecotech releases ebooks for the renewable energy workforce



Ecotech Institute has announced the release of two free comprehensive e-book guides to starting a wind or solar energy career. These guides cover everything from a day in the life of renewable energy technicians and potential salary earnings to required skills and advice from professional solar and wind technicians.

The wind and solar energy renewable energy industries are booming, but that doesn't mean getting a green job is easy. These occupations take specialized training, cleantech industry knowledge and passion to secure a career. Now, future solar and wind technicians have one place to access vital information, including:

Key industry facts about the renewable energy sector; tips for job seekers in the energy efficiency field; expectations and requirements for wind and solar energy green jobs; cleantech employment trends; and advice from working industry experts and technicians.

To download the e-books, visit: www.ecotechinstitute.com/ebook/

MHI Vestas prototype breaks 24-hour production record

MHI Vestas Offshore Wind's V164-8.0 MW prototype set a new benchmark for power production recently when the turbine produced 192,000 kWh in a 24 hour period, enough to power approximately 13,500 Danish households, demonstrating the full capability of the world's most powerful wind turbine.

The V164-8.0 MW prototype turbine has broken the record for power production by a wind turbine in a 24 hour period from 6-7 October 2014 when the turbine produced 192,000 kW/h, during steady wind conditions at the test site in Østerild, northern Denmark. The power produced by the turbine in one day was enough to supply the energy needs of approximately 13,500 Danish households, roughly equivalent to Thisted; a city close to the test centre.

The power production data was measured by Denmark's Technical University (DTU) who own the Østerild site.

MHI Vestas Offshore Wind's CEO Jens Tommerup said the record demonstrates the full capacity of the V164-8.0 MW.

"This power production record further underlines both the quality of the technology as well as the skills of the team involved who have been working hard to ensure the turbine is performing according to our testing schedule," Tommerup said.

Siemens awarded 15-year extension on service and maintenance agreement for Washington wind farms

Siemens has signed two long-term wind service and maintenance agreements covering 132 SWT-2.3 turbines at two wind projects in Washington state.

Summit Power Group, LLC, based in Seattle (managing member of White Creek Wind I, LLC "White Creek" and asset manager of Harvest Wind Project "Harvest Wind") represented the two projects.

Under terms of the agreements, Siemens will provide an additional 15 years of service and maintenance for 43 SWT-2.3-93 turbines operating at the Harvest Wind Project and for 89 SWT-2.3-93 units at the neighboring White Creek Wind project.

Both are located near Roosevelt, Wash. Siemens has been servicing the turbines at both sites since the start of commercial operation — 2007 for White Creek and 2009 for Harvest Wind.

"As the wind energy industry in the U.S. continues to mature, it's important that we work closely with our customers to help maintain the continued reliability, availability, and economic efficiency of their units over the long term," said Randy Zwirn, President and CEO of Siemens Power Generation Services.

"With our significant focus on R&D, as well as advancing technologies, such as remote diagnostics and data analytics, we can gain valuable insights that can help contribute to our customers' long-term success. We look forward to continuing our service operations at White Creek and Harvest Wind for many years to come."

— Source: Siemens

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Yahoo! and OwnEnergy enter 15-year Power Purchase Agreement for Kansas wind energy project

OwnEnergy, a national leader in the development of mid-sized wind farms, announced that it has entered into a long-term Power Purchase Agreement with Yahoo!, Inc.

Under the terms of the 15-year PPA, Yahoo will purchase wind power, expected to reach 100,000 MWh annually, which will be used to offset much of Yahoo's energy usage in the Great Plains region of Kansas.

"It's great to see a leading tech company like Yahoo working to expand the use of renewable energy, and its involvement in this project will enable us to generate both local jobs as well as financial upside for members of the Rush County community," said Jacob Susman, Founder and CEO of OwnEnergy.

OwnEnergy partners with energy entrepreneurs across the country to develop wind projects. The company's local partners are leading members of wind-rich communities who play an active role in project development and receive a share of project ownership in return.

"At Yahoo, we're committed to being an environmentally responsible company," said Chris Page, global director, energy and sustainability strategy. "Driving the development of cleaner and renewable sources of power is an important piece of our sustainability strategy. We're proud to partner with OwnEnergy in a community-based project that increases the amount of clean, sustainable energy in the Great Plains region. We take care in ensuring that we are an engaged member of the communities in which we live and work. This partnership is a fantastic opportunity to improve Yahoo's energy sustainability while contributing to the community in Rush County and across the region."

While Yahoo is one of the first tech companies to embrace this model of community-centric partnership, the trend for corporate purchasers to buy wind directly from wind farms is gaining pace.

"OwnEnergy's business model taps into the entrepreneurial spirit of farmers, ranchers and landowners across the United States, providing them with economic opportunities, operational resources and industry expertise necessary to develop a source of clean, renewable energy," said Susman. "We look forward to working with an industry leader like Yahoo, a company that shares our commitment to clean energy and to supporting the economic prosperity and social well-being of local communities across the country."

— Source: OwnEnergy, Yahoo!