Where No Wind Has Gone Before

SheerWind's innovative technology creates wind power in areas thought impossible in the past.

The 100 kW Invelox installed at the Michigan Army National Guard is upgradable to 500 kW. (Courtesy: SheerWind)

By Kenneth Carter
Managing Editor | Wind Systems

Using wind to create clean, renewable energy is a noble goal. It's also a goal that's quickly becoming more economical and profitable. But in order to make the power, nature has to make enough wind.

Wind is abundant around the world, but it's not everywhere around the world. Unfortunately, this simple geographical fact has kept many areas from taking advantage of this clean-energy production method.

SheerWind in Minnesota has a solution to the no-wind scenario. Its patented Invelox system overcomes the problem by creating useable wind in areas where traditional turbines are ineffective.

The L-shaped Invelox — short for Increased Velocity — looks like Dr. Seuss dreamed it up for Whoville's town square, but it's that unique geometry that brings wind power to wind-starved areas.

"Rather than putting turbines where the wind blows enough to turn them, we are controlling the wind and increasing its speed, and then putting the turbines in that area where we've increased the speed," said Carla Scholz, chief marketing and communications officer with SheerWind.

HOW IT WORKS

Wind is captured at the top of Invelox's funnel. Depending on power needs, the funnel can be anywhere from 26 feet to more than 720 feet high. The funnel is open on all sides, so wind can be captured from any direction. As the wind is funneled through the system, it is concentrated and accelerated.

That wind — now made faster as it flows through a narrower corridor — flows across up to three ground-based turbines that convert the artificially accelerated air into electricity.

Finally, that air enters a diffuser, which slows the wind and returns it back to nature.

"It's very much like a hydro dam," Scholz said. "Because we're just squeezing that air just like they squeeze water."

The real beauty of the Invelox system is that it can be installed just about anywhere, she said.

"The current wind technology has to go into wind corridors," Scholz said. "That's where the birds are flying. And that becomes an issue. What we're finding now is putting them where nothing else will work is our sweet spot."

PALMYRA ATOLL

As an example, Scholz points out the Nature Conservancy's wildlife research island at the Palmyra Atoll overseen by the U.S. Fish and Wildlife Service.

The Atoll, about 1,000 miles southwest of Honolulu, is home to more than a million protected nesting birds. The facility there was running primarily on diesel fuel. It had installed some solar, but it wasn't generating the needed power, according to Scholz.

"They could not use a traditional wind-turbine system for two major reasons: No. 1, it wouldn't turn," she said. "Because even though it's out in the middle of the Pacific, their wind speeds are not great. Which is surprising. Apparently, there isn't wind everywhere in the ocean like we all think there is."

The second major reason was to protect the island's wildlife.

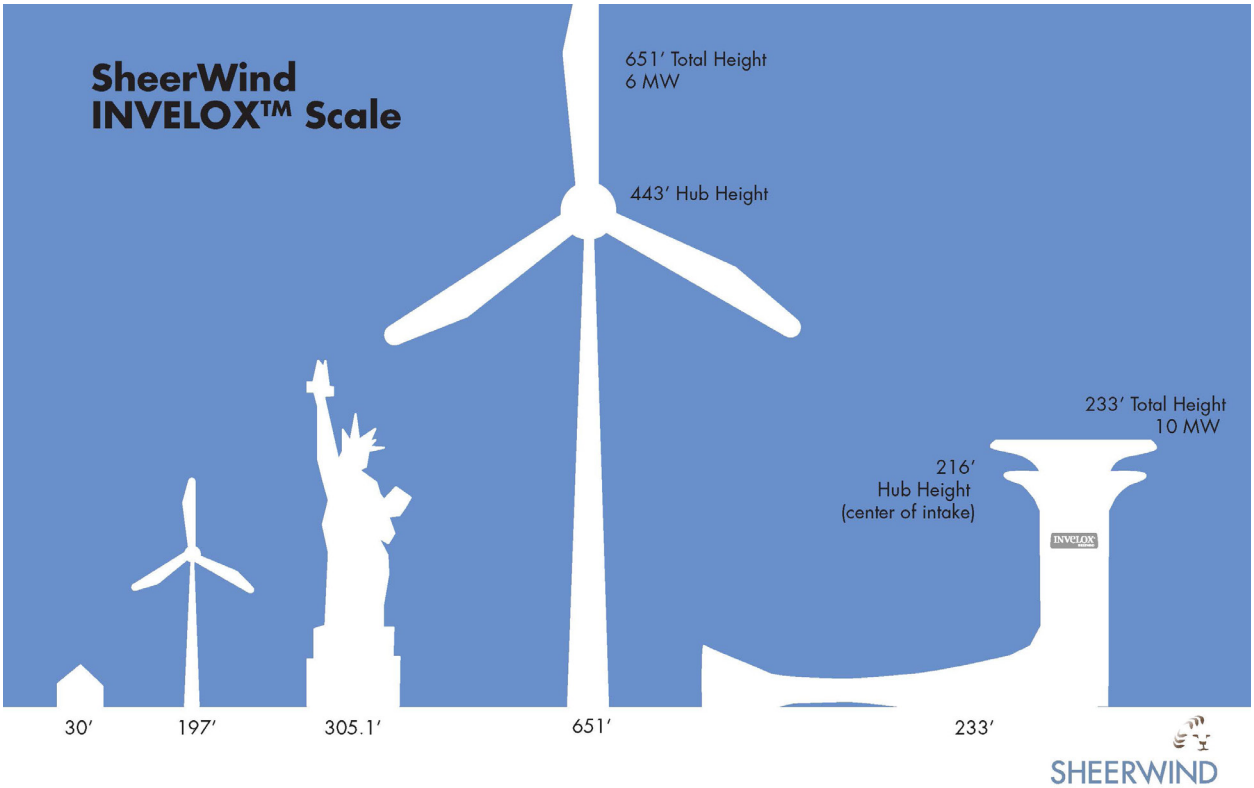
"They said, 'No way, you can't put up any kind of turbine; it's not gonna happen,'" Scholz said. "Not to mention, that it probably would have been taken out in a few days by the number of birds."

The Invelox system doesn't have the potential adverse effect on birds, but as an added safety precaution, the system at Palmyra Atoll had nets installed over the intake and outtake areas, according to Scholz.

"There's a net that can actually protect birds from flying in from any direction," she said. "However, we have our model in Chaska, Minnesota, and it's been here now for nearly five years, and we've never had any issues with birds."

MICHIGAN NATIONAL GUARD

Since all government facilities have been mandated to find ways to use renewable energy, the Michigan



National Guard also has been able to benefit from the Invelox system.

"There's no wind to speak of in Michigan," Scholz said. "It's just one of those places where there's not a lot of wind."

The Army Guard facility tried solar panels, but they weren't getting the job done. And even if there was decent sustainable wind, a wind farm near a military base can create its own set of unique problems.

"You can essentially fly a drone or something through a wind farm undetected because the radar interference is so great," Scholz said. "That's the reason the Michigan Army National Guard was willing to take a chance and help us figure this out. And working together, they've been fabulous to work with because they're in a hard spot, and we really want to help them."

The guard unit now uses three Invelox units, and two more are nearing construction completion. They are expected to be operational sometime in 2017, according to Scholz.

Many of the concerns associated with large wind turbines also are eliminated with the Invelox system.

"Our blades are 60-percent smaller," Scholz said. "And it's also ground based, so you don't have to be a professional climber to work around our turbines."

Low-frequency noise and blade flicker also are eliminated, according to Scholz.

BLENDING IN

The unusual shape of the Invelox system definitely catches the eye, but for businesses that think it might be too "out there," there's a solution.

"As long as the geometry of the Invelox stays the same on the inside, you can put any structure around the outside," Scholz said.

The critical intake and outtake of the Invelox have to remain unobstructed. "(But) they could essentially look like anything," she said.

Invelox has been operating since 2012, when the pilot program went online at Sheerwind's Minnesota headquarters.

Since then, SheerWind operates through distribution hubs, according to Scholz.

"We've gone that route so we can get our technology out around the globe faster, with the idea that you can basically build the funnel out of anything that we say will work," she said. "We've used fiberglass and steel and plastic. So, that way (a hub) can engineer based on our IP."

The Invelox system has the potential to bring wind power to areas that simply could not support it before.

It's scalable across the wind-industry spectrum, and it can be used anywhere from community-sized settings to major wind farms.

The concept is simple, according to Scholz. But the science and engineering behind Invelox is anything but.

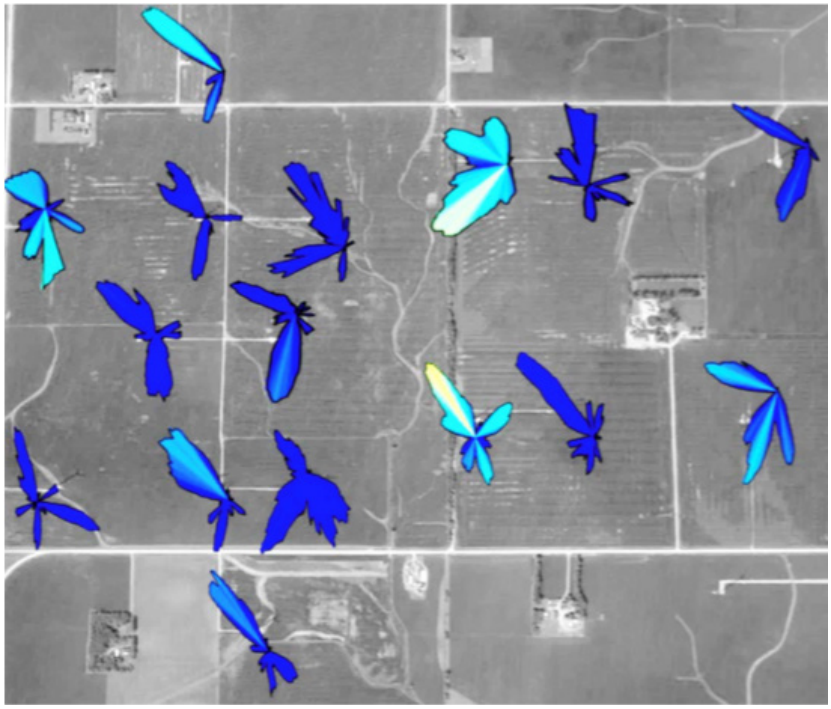
Looking at the Data

New studies to open door to 99.5 percent wind-turbine reliability.

By Jason Deign

Improving wind-turbine reliability to 99.5 percent will require new data analysis approaches across the industry because existing techniques keep the sector from going above current reliability levels, according to Carsten Westergaard, senior adviser of Wind and Water at the Sandia National Laboratories and professor of Practice at Texas Tech University.

"We're no longer talking about the 50- or 60-percent reliability of the '80s," Westergaard said. "Today, a good turbine is probably 98 percent. We want to go to 99.5 percent. And you can't just do that with a logistics mindset alone."



Turbine fault counts based on data over 1.5 years, showing massive variability between machines (Courtesy: C.H. Westergaard, S.B. Martin, J.R. White, C. Carter and B, Karlson, "Towards a more robust understanding of the uncertainty of wind farm reliability," to appear in Probabilistic Prognostics and Health Management of Energy Systems).

LIMITATIONS

Sandia has been tracking multiple wind-farm supervisory control and data acquisition (SCADA) streams since 2007 through its Continuous Reliability Enhancement Wind (CREW) project, but it has reached the limits of how this data can help in understanding reliability.

Gauging wind-turbine reliability from various data sources is highly complex because the boundary conditions for the data are often undocumented and significantly affect the outcome of aggregation, according to Westergaard.

At the same time, most of the financial models the industry is using are limited in how they enhance reliability since they tend to focus on the cost of faults rather than on what technically causes failure.

Finally, Westergaard said benchmark averages drawn from current data sets might fail to account for the impact of discrete events such as lightning strikes.

Lightning typically causes multiple small fractures, Westergaard said. The industry has become adept at spotting and repairing those, often within a week or two. It used to take more than 12 months.

However, being able to repair the damage does not mean asset owners are closer to understanding why it happens in the first place.

"Out of a thousand turbines, you may have three major lightning-strike damage incidents a year, on a fleet of, say, seven different types of turbine," Westergaard said. "That's not enough to get clever on. It's an area where shared knowledge would really be good."

To date, he said the wind industry has not been good at sharing data. This means current reliability benchmarks may be inaccurate.

In the case of lightning, for example, benchmarks are based on experience gained in coastal Northern Europe, which has an average of 15 days of lightning a year, compared with California with almost zero and Texas with about 75.

NEW ANALYTICS

To overcome these limitations, Sandia is working to make it easier to aggregate wind industry data so more complex analytics can be applied to gain a greater technical understanding of reliability.

As a first step, Sandia is developing a common data-tagging framework that can be used to integrate different future and past data sets.

Westergaard said the framework could be incorporated into an audit process to ensure it is used across the industry. This could help asset owners gain a greater understanding of the causes of failure and ultimately lead to a 1.5-percent reduction in faults, he said.

Researchers also hope to uncover fault patterns that cannot be predicted on a single-turbine basis.

One of the surprising findings in the Sandia data is that identical turbines can have different performance and reliability profiles even on the same wind farm, Westergaard said.

This could be due to the way each turbine interacts with others and with other elements in the environment. However, this variability is not fully captured in current reliability and performance models and financial comparisons.

"We're so used to thinking of a turbine as a turbine, but we're not really thinking of it as an element that is interacting with other elements," Westergaard said. "Looking at the data, it was mind-blowing in its diversity."

Moreover, according to Scott Abramson, director of operational excellence at Duke Energy Renewables, breaking down the information or data about wind turbines by specific technology allows owner-operators to analyze and compare data more accurately since there is a large disparity in operation and downtime between technologies.

The Sandia initiative to standardize, integrate, analyze, and understand reliability data is still in its early stages, and the development of a proof-of-concept system will depend on further funding.

If this is forthcoming, Westergaard said the proof of concept could start yielding results within a year and a half.

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Jason Deign is a Barcelona, Spain-based journalist, editor, and author who has been reporting on the renewable energy sector since 2010. He is a regular contributor to a range of clean-tech publications. Deign also writes widely on new technology, speaks at events, and has authored a number of industry reports.

HV Cast Resin Joints Rated to 170 kV for Pluggable Cable Connections

The Connex size 6 cast resin joint. (Courtesy: Pfisterer)

Pfisterer has expanded its line of gas-free joints with the dry, pluggable Connex size 6 cast resin joint. The new cable connection for voltages of up to 170 kV is quick and easy to install, which is why it is particularly well suited to offshore assembly operations on ocean platforms and is compatible with versatile emergency mobile transformers. Different cable cross-sections and materials can also be combined. Pfisterer's new cast resin joints are being used in offshore projects in the North Sea and for newly developed emergency mobile transformers in the U.S.

Connection joints made from cast resin fitted with the pluggable Connex connection system from Pfisterer are solid insulated and facilitate easy handling at the place of installation, without requiring any gas or oil work. This, in turn, makes it possible to quickly and easily install the equipment. With the Connex cast resin joint in the new available size 6, convenient installation is also possible in the HV range up to 170 kV. The cable joint can even be temporarily installed in test centers or used as an interim solution during line construction. For permanent installations, the joint is preferably fitted where cables not only can be connected quickly and safely, but also in a space-saving manner. This is the case with converter stations for wind farms in the North Sea as well as with mobile power transformers.

PREDESTINED FOR OFFSHORE

Space is tighter in converter stations in the open water than in corresponding substations on land. This is why the compact construction of cast resin joints is a significant factor when it comes to offshore platform installations. The solid insulated, touch-proof Connex joints allow cable systems to be implemented in much tighter areas than with SF6 joints. Connex joints are also resistant to salt water and UV radiation, are submersible, require zero maintenance and are certified for offshore applications by the DNV GL classification body. An installed longitudinal water barrier prevents any water ingress that could be caused by a cable fault.

VERSATILE COMBINATIONS

The size 6 Connex cast resin joint can connect cables of different diameters in a single joint. Various conductor materials such as aluminum and copper as well as rigid and flexible cables also can be connected. The connection joints likewise comply with international standard norm IEC 60840 for high-current cables. A voltage tap has been integrated as an additional component. Together with permanently installed voltage testers, this tap makes it possible to check voltage levels at a safe distance as well as facilitates additional testing opportunities.

With the new size 6, Pfisterer offers gas-free, dry, and pluggable cast resin joints for voltage ranges from 36 to 170 kV. Tap-off joints (T-joints) are planned for the next development step so that multiple cables can be simultaneously connected.

Source: Pfisterer

For more information, go to www.pfisterer.com