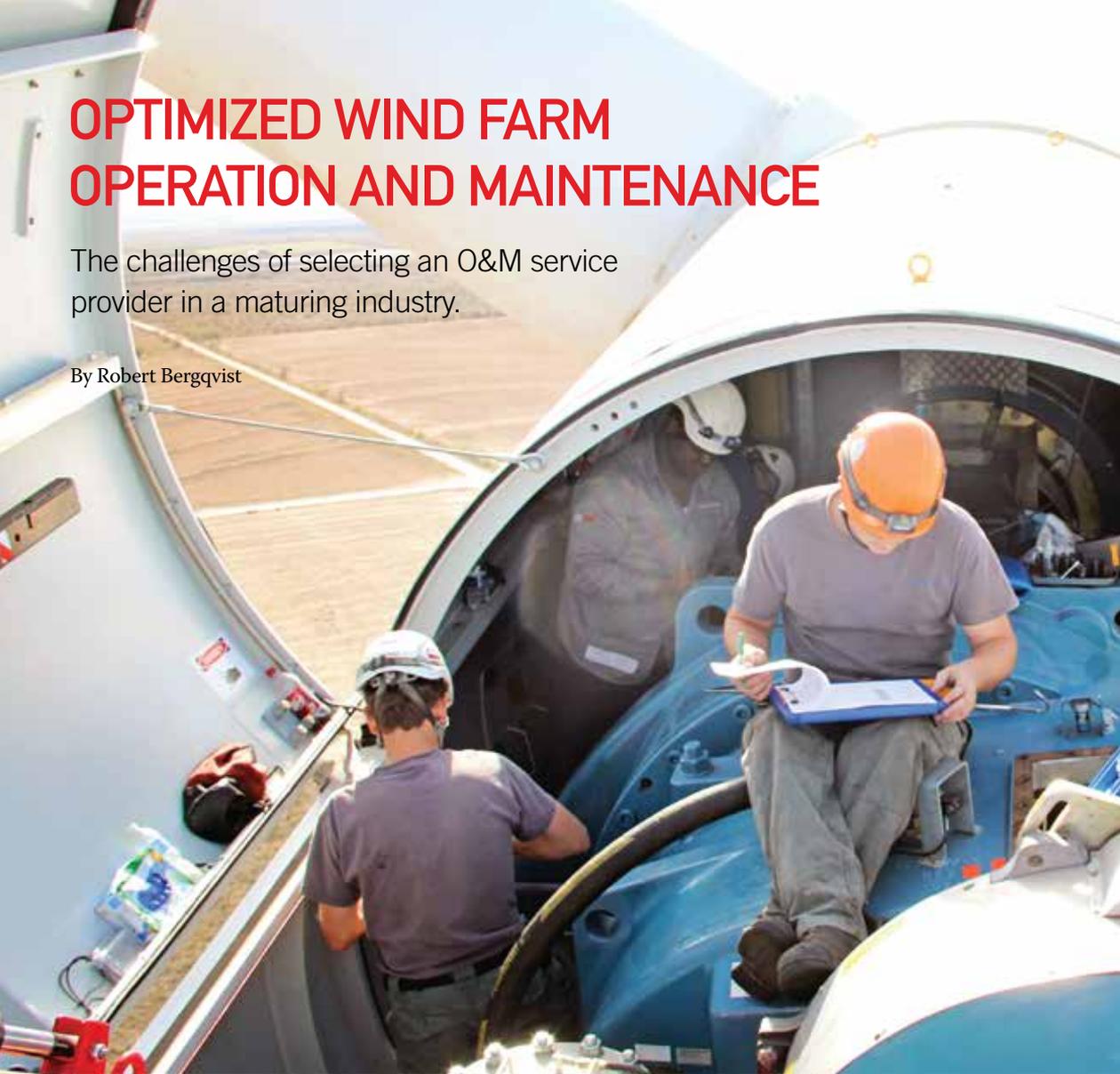


OPTIMIZED WIND FARM OPERATION AND MAINTENANCE

The challenges of selecting an O&M service provider in a maturing industry.

By Robert Bergqvist



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WIND FARM OWNERS ARE FACED with many challenges to increase availability and production and reduce costs, all while performing safer than last year and with higher levels of quality. In addition, competing with the price of electricity from other sources of energy generation requires the highest standard of service for the lowest comparative cost. In other words, the owner's service provider must deliver more production for a fixed price that equates to a lower cost of electricity, ultimately giving the owner a better Return On Investment.

Overcoming these challenges is easier said than done, especially if you're not in 100 percent control

of all steps involved in performance excellence. Wind farm owners rely on a supply chain every day to get spare parts, solve engineering problems, complete daily operations, execute planned maintenance and manage unplanned events. This supply chain is made up from companies that offer products and services throughout the wind farm's lifecycle—from independent engineering firms to development contractors, the wind turbine Original Equipment Manufacturers (OEMs), Independent Service Providers (ISPs), providers of spare parts and consumables, supplement labor contractors, inspection services vendors, etc. At



owners have to take measures to get in control of their assets and not solely rely on their vendors. When buying wind turbines for a specific trust and signing up for the warranty and the initial years of Operations and Maintenance (O&M) services, there is a great deal of trust that is placed on the selected vendor. Since we're likely to see a number of wind turbine OEMs go out of business in 2013-2014, the selection process need to evaluate the likelihood of vendors being able to stay in business and grow their business at a sustainable rate. Unfortunately, one cannot rely on that the best technology will prevail. The vendor's ability to sell and service their customers, the way that their customers want to, also has to be weighted in, in addition to a number of other factors.

LIBERATING DATA AND DRIVING PERFORMANCE

For the thousands of wind turbines that are already operating, the wind turbine vendor selection has obviously already been made and the question at hand is how to manage that situation. Many wind farm owners have been doing their best to overcome operation manuals, drawings and master parts lists. Some have even made a conscious decision to invest in staffing and building up an in-house O&M organization with safety and quality programs of their own in order to not have to rely on their supply chain much. The investment that it requires to take on such an endeavor is however not something that every wind farm owner can stomach, and even so, it is not without

selection of vendors, for the various services and products needed, the wind farm owner places a great deal of trust on the vendor to perform in the best interest of the wind farm owner.

As the industry continues to mature, the quality of service and the capabilities of both OEMs and ISPs vary dramatically. In this context, it is essential that wind farm owners understand the breadth and depth of offerings from their existing, or potential, vendors. Identifying those who deliver value on a consistent basis and those who will continue to evolve and improve the solutions they provide to their customers. Equally important, wind farm



risks one expands beyond core business processes and know-how. The O&M services still remain part of the supply chain; it's just that the risk is now all on the wind farm owner. Managing hundreds of qualified technicians, asset condition, maintenance programs, etc. is quite different in nature compared to financing and developing wind farms. Safety, quality and training needs to be continuously measured and improved in order to reach an availability factor of 98 percent and above. There's no easy way around that and substantial investments has to be made on a continuous basis.

A wind farm owner who has concluded that they need to be in control of their destiny will soon learn that doing so does not come without the challenge of gaining knowledge of turbine condition, wear and tear, potential serial defects, and even whether or not the service teams perform the scheduled maintenance according to plan. Monitoring the service provider couldn't be more important in an environment where you're paying dearly for a warranty or rely on operation and maintenance providers that provide labor without support from their own quality and performance improvement system. One can also ask oneself whether the OEM recommendation for scheduled maintenance, spare parts replacements and use of consumables really is optimal from an asset management and production perspective. Further, if the maintenance schedule is built to manage an issue inherent to the design of the turbine, is the provider of the O&M services really incentivized and equipped to recommend alternatives that improve the wind farm owners cost structure and production?

Wind farm owners need to find cost effective means to understand the condition of their assets

and to ensure that they are operated and maintained in the best interests of the owner. Condition Based Monitoring (CBM) solutions can tell a lot about the condition of wind turbines. But as most CBM systems were originally developed for gas turbines, steam turbines, large diesels, etc., the price point of those systems don't always fit the wind industry where unit output usually is in the 2MW range, compared to 1,000MW for steam turbines. A CBM system with many bells and whistles may not pay for itself when installed on a wind turbine—as the requirements for return on investment usually is shorter than five years. And yet, even if the very detailed reporting and analysis that is commonly delivered by the CBM systems of today, a decision is still likely to be made to dispatch a team of technicians to go out to the turbine and visually inspect the turbine, listen for abnormal sounds and borescope the gearbox. The cost of dispatching a small crew for a few hours is relatively small and the crew is usually already available on the wind farm site.

SQUEEZING VALUE OUT OF THE WARRANTY

Wind turbine field inspections are a very common means of base lining the condition of the assets and to support warranty claims. Wind farm owners realize that it's of essence to plan the End of Warranty (EOW) inspection to ensure that enough time has been allocated for inspection of all turbines, analyze the results and file claims well in advance of the end of warranty date. By planning the EOW inspection well in advance, wind farm owners can maximize the understanding of the wind turbines and any safety, quality or technical

issues they may have. In turn, this knowledge enables the wind farm owners to take full advantage of the value of the warranty. Good planning will afford the inspection team the appropriate window of time to complete the inspections in full, taking time to address critical findings in detail and producing high quality reports that enable the owner ample time to report back to the OEM in the appropriate manner, before the end of the warranty period.

To really optimize the EOW inspection, it is good practice to perform baseline inspections at the time when the units are first commissioned and placed into operation. This baseline enables the comparison of the current condition of the asset (at EOW) to the condition of the units at commissioning. It is an excellent way to track changes and justify claims that may stem from unusual wear and tear or unexpected failures. An asset inspection is also an inspection of the O&M service provider, regardless of whether it's performed during or after the warranty period. In the 3,000-plus EOW inspections UpWind Solutions has performed, we have found that a clean turbine usually reflects a well maintained turbine. Trash on the decks, uncleaned grease and oil spills, missing torque stripes, and so on are usually indications of underlying issues with asset health. It is therefore good practice to include general cleanliness and upkeep in the inspection scope of work as this is a very good indicator of potential future problems.

Not all warranty claims are approved and not all damage warrants a warranty claim. Regardless, the wind farm owner still owns the asset and has a vested interest in making sure that they are in control of future planned and unscheduled maintenance and its associated cost. The EOW inspection

provides a baseline assessment of the condition of the turbine going into the post warranty period. This baseline assessment educates the asset owner to identify specific units and/or components that could need further inspection in the future and potentially maintenance reduced interval between

maintenance activities. An extensive asset knowledge base may even extend the maintenance cycle if applied correctly. The key is understanding the asset condition in full and planning accordingly, where the baseline assessment provides for effective planning of maintenance programs going forward.

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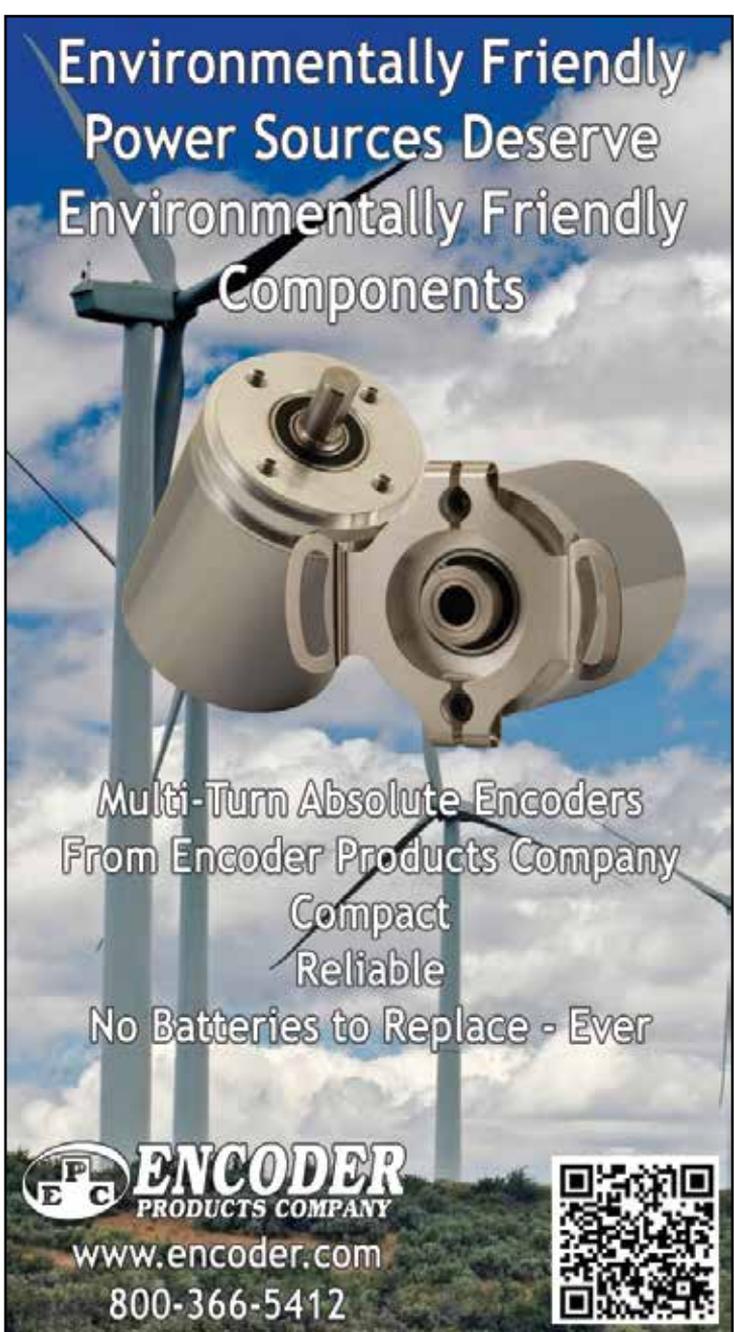
The areas mentioned in this article highlight the need for an integrated asset management solution that help wind farm owners liberate and capture a continuous flow of data from operational experience,

performance indicators, turbine health indicators as well as field inspections. Careful attention has to be given to managing the overall cost of the solution and balancing the capabilities and cost of the various components that build it. With a cost effective asset management solution established, wind farm owners can focus their

attention to closely managing the maintenance and repair activities, optimize the usage of spare parts and consumables, as well as implementing suitable wind turbine upgrades.

The successful wind O&M service providers of the future will distinguish themselves by being able to provide a complete O&M solution that combines discreet complimentary offerings. The wind industry is unique in the way that each unit produces single-digit MW power but also in that the number of units in the fleet completely outnumbers any other form of electricity production. In such an environment wind farm owners should demand that their operation and maintenance services providers have the capabilities to:

- Offer significant price reductions for spare parts and consumables
- Provide alternative parts that can extend the maintenance cycle
- Perform flawless repairs of gearbox, generator, blades, rotor, hub, etc.
- Upgrade drive trains and other critical components to extend the maintenance cycle
- Install blade vortex generators to improve yield
- Capture turbine tags and drive train data for instant and historical analysis in order to predict failures
- Supplement the analytics with comprehensive field inspections that identify wear and tear
- Store inspection data from large inspection campaigns and sporadic condition inspections on a continuous basis
- Support the field operation and maintenance teams with 24/7 remote monitoring and engineering resources
- Provide benchmarking of performance data with the rest of the fleet



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