WIND ENERGY update

REPORT EXTRACT

WEU Onshore O&M Report 2014

Cost effective O&M strategies to minimize downtime and maximize wind energy yield

O&M Strategies and Routes to Improvement

Find out which strategy is best suited to your operations. A closer look at: Reactive maintenance; Preventative maintenance; Preventative activities

Component Reliability

Get the latest data on failure rates, causes, financial impact and solutions to help ensure you have a robust O&M strategy in place

Benchmarking Operations

Gain industry insight on how operators across the globe are approaching O&M to compare and benchmark your operations

For more information visit **www.windenergyupdate.com/onshoreOandM**

WIND ENERGY update

The extract below was taken from chapter two of the WEU Onshore O&M Report 2014.

This chapter provides the survey results on the maintenance approach taken by different operators, OEMs and independent service providers. The survey received responses from more than 120 qualified wind industry professionals.

Chapter four and five shed more light on the financial implications of each approach. Chapters four offers further insight into the most common causes of failure, costs of repair and downtime caused. Chapter five delves into the cost-effectiveness of different O&M strategies as well their impact on availability.

2

Mapping the O&M landscape

Chapter Summary

- O&M strategies can be considered to fall within four categories: reactive, preventative, condition-based/predictive and reliability-centered.
- Reactive maintenance – fixing something only once it has failed – is still the main O&M approach for over a quarter of operators questioned for this report. Reactive maintenance is indeed appropriate in some circumstances; for example, there is little that can be done to prevent rotor damage caused by a severe lightning strike. In other circumstances though, reactive maintenance can lead to avoidable costs due to the replacement of components that have catastrophically failed due to inadequate maintenance procedures.
- Preventative maintenance is the preferred approach for half of the operators surveyed for this report – this approach anticipates problems by carrying out regular, fixed-schedule maintenance on components known to deteriorate over time. Preventative maintenance is known to be effective in improving reliability, although it usually relies on assumptions about how frequently checks should be made, and as such may not provide the optimum balance between reliability and replacing components unnecessarily.
- Condition-based (also known as predictive) maintenance uses data from monitoring equipment to assess the rate of deterioration of components – the monitoring is typically carried out using dedicated CBM tools; however, some operators have successfully utilized the performance data from standard-fit SCADA equipment to determine which turbines are operating with sub-standard performance.
- The application of condition-based maintenance needs careful consideration – it is not cost-effective to monitor all components; therefore this approach should be applied to areas where the risk of failure has the greatest financial impact. Operators should also consider the approach to analyzing CBM and SCADA data to ensure that the time and expense do not outweigh the savings – the adoption of appropriate software may help with filtering and prioritizing problems which these systems highlight, and reduce the need for manual intervention.
- Reliability-centered maintenance is also occasionally adopted, utilizing data from past component records of deterioration and failure to more accurately predict when existing components are due for service or replacement.
- The various approaches outlined above can be implemented within one or more O&M strategies. Conventionally, new turbines come with a manufacturer's warranty, usually of around five years. Once this warranty expires, operators can often choose to extend it for anything up to 20 years. The WEU Onshore O&M Survey carried out for this report shows that operators tend to re-evaluate their O&M strategies every five years – a period reflecting a typical O&M contract length. At this point, operators can choose to move to an ISP, or even carry out certain tasks in-house if they have the capability. In some circumstances, a hybrid approach may make most economic sense.
- The benefit of choosing OEMs is that they should know their turbine models inside out. Nevertheless, they are often reluctant to share operational data, putting operators at a disadvantage if they choose to move to an alternative strategy at a later date. OEMs can also tend to be more expensive than the alternatives.
- ISPs typically offer a more flexible service than OEMs, and potentially a broader range of services including field as well as turbine O&M. Such flexibility can also be useful if an operator's portfolio encompasses turbines from a variety of manufacturers. On the downside, they may not have the same access to components as the OEMs, limiting their ability to rapidly resolve major problems.

- In-house maintenance can be a worthwhile option for larger operators with the resources to manage certain aspects themselves. As with ISPs, in-house technicians are more likely to have the capabilities to handle field O&M – a conclusion backed up by the results of the WEU Onshore O&M Survey.
- The O&M market is expected to continue to evolve over time as technological developments encourage a shift away from reactive and preventative maintenance approaches.

The previous chapter laid out the current status of the O&M market, setting the scene in terms of scale and growth trends and highlighting some of the challenges that the sector is current grappling with.

This chapter takes a look at the state of play with regard to current O&M practices. The first section presents an overview of the various models for O&M strategies, describing both the main fundamental approaches to O&M as well as laying out the options available for who should be carrying out the maintenance operations. The chapter then moves on to examine how O&M strategies are likely to change moving forward.

In later chapters, each approach will be assessed according to its implementation cost and impact on reducing failures, allowing operators to compare the performance of their current approaches against industry norms, enabling an informed decision to be made as to any change in strategy.

This analysis comes at a critical time not only for operators, but also for suppliers looking to make the most of the growing number of opportunities available for providing O&M services. Successful O&M suppliers will align their service offerings in anticipation of the requirements of wind farm operators. To do so requires a detailed understanding of the elements of a strategy that will lead to a reduction in operating costs and a return on O&M investment.

2.1 O&M models used in the wind industry

A key decision to be made by wind farm operators is that of who should carry out O&M tasks. It is usual for the turbine manufacturers (often referred to as the OEMs) to supply O&M services during an initial warranty period that typically lasts for two to five years, which may be extended for a further period of up to 20 years. As an alternative to OEM servicing, operators may outsource to an ISP, or undertake much of the work themselves if they have the skills in-house. Some operators will combine elements of these different approaches according to their own skill-sets and circumstances. These so-called hybrid approaches attempt to optimize O&M arrangements between the various parties to drive down costs without compromising service levels.

This decision about who should carry out O&M work must take into account a number of factors, including the costs and terms of any contractual agreement – for example, whether the warranty will cover loss of income from downtime. The most appropriate strategy may also differ according to the age of the wind farm. Evidence presented later in this report points to the jump in failure rates of some capital-intensive components past a certain age. As a result, younger wind turbines may not require the level of maintenance of older models, and this reduced level of risk may initially justify a lower-cost approach.

There are essentially three parties who can carry out O&M work: OEMs, ISPs or the wind farm operators themselves (through in-house teams). The choice of service provider can be crucial for an operator, especially for those with large portfolios where O&M costs can become significant. This section considers the various options for O&M service provision, looking at the status quo and assessing the pros and cons of each approach.

2.1.1 Original equipment manufacturers

2.1.1.1 Initial OEM warranties

OEMs dominate the O&M scene during the early years of a wind project's lifespan. Most wind farms will be covered by an initial warranty period with the OEMs of the turbines and other site equipment. This initial warranty is usually around two to five years, and during this time the manufacturer is generally responsible for all repairs.

The initial product and service warranties of two to five years are often provided at a discounted rate, and there are clear benefits in using the expertise of the turbine manufacturers. OEMs are often set up with round-the-clock monitoring and support facilities, and can provide a rapid response to problems. On the downside, O&M

costs are often hidden from operators, having in many cases been effectively discounted as part of the initial sales process. The condition of the turbines is also usually unknown other than to the OEMS, and operators would be well advised to carry out end-of-warranty inspections several months before the warranty expires in order to avoid unpleasant and perhaps expensive surprises.

2.1.1.2 Extended OEM warranties

As the initial warranty comes to an end, it is quite common for OEMs to offer to extend the cover for a further period, typically for five to 15 years. Such an arrangement often makes good sense, especially considering that overall wind turbine reliability starts to fall more rapidly after six or seven years. OEMs should know the foibles of their turbines better than anyone, have immediate access to spare parts, and will often offer to cover the financial risks of unexpected downtime too. These kinds of features are particularly attractive to smaller operators, and moreover are often the preferred arrangement for the banks and other financial institutions providing the capital investment.

On the downside, an OEM may be inclined to deny or hide inherent problems with the turbine to evade potential costs associated with resolving them – a situation where having an ISP may be more in the operator's interests. Contractors outsourced by OEMs to carry out under-warranty repairs may also cover large geographical areas, and as a result be reluctant to "take ownership" of problems.

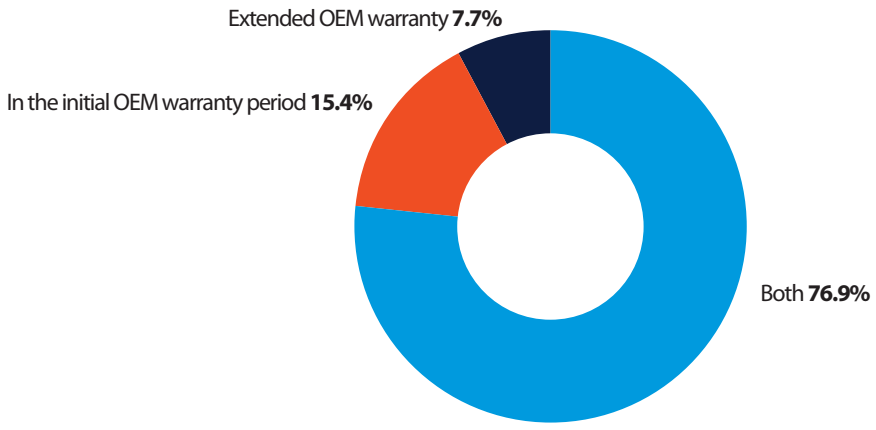
OEMs have a number of motivations for extending O&M warranties past the initial period, not least because in some markets demand for new turbines is slowing down, whereby O&M services become a more important source of an OEM's income. Suppliers are also keen to hang on to experienced maintenance personnel – the opportunity to be assigned to particular wind farms on a longer-term basis is bound to be attractive to many wind farm technicians.

As part of WEU Onshore O&M Survey, OEMs were asked about the warranties they provided (Figure 7). 15% offered only initial warranties, and just 7% offered only extended warranties. The vast majority of providers offered both kinds of warranty, perhaps reflecting the growing proportion of income achievable through these services compared with simply selling turbines.

Looking at what advantages their services offered over their O&M competitors, OEMs mentioned their product-specific know-how, support tools, performance and availability guarantees as being particularly beneficial to clients. The majority of OEM respondents identified ISPs as their biggest competitor in the O&M marketplace. The following is a full list of stated OEM advantages from the survey:

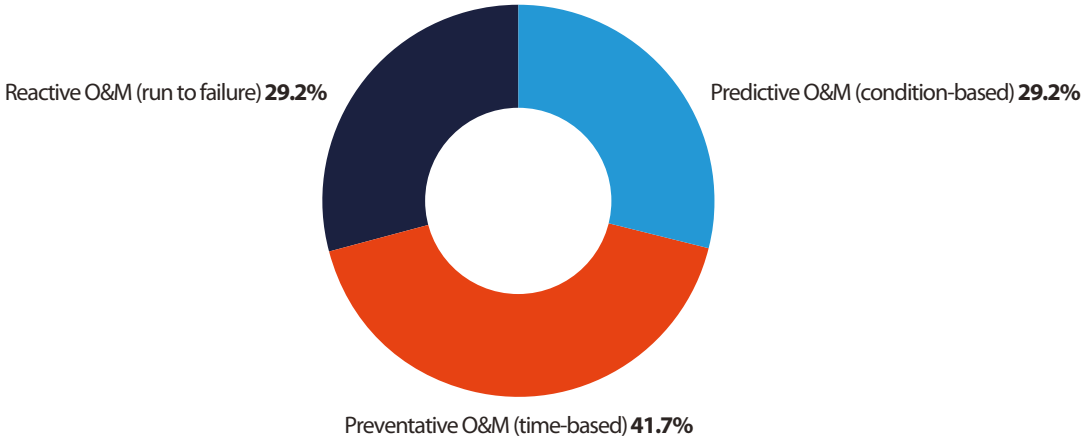
- Constant monitoring
- Demonstrated performance
- Highest availability
- Multiple brand & technology
- OEM know-how
- Price

Figure 7: Which of the following O&M services are offered to wind farms?



(Source: WEU Onshore O&M Survey 2013 – Strategies and approaches)

Figure 8: In which of the following O&M response scenarios are O&M component service most commonly deployed?



(Source: WEU Onshore O&M Survey 2013 – Strategies and approaches)

- Quality
- Quick response
- Reliability
- Technical assistance
- Tools
- Warranty terms.

Despite the evident advantages of using OEMs for O&M, wind operators' views of OEMs have been dented in recent times by their unwillingness to share operational data during the warranty period. Not only does it make the verification of lost generation revenue difficult, this situation can put operators at a significant disadvantage when the time comes to cut loose and develop their own maintenance strategy. As this report makes clear, historic operational data are invaluable as a tool to help reduce operating costs over the longer term.

Concerns have also been raised about the potential conflict of interest in OEMs being spare part suppliers as well as O&M providers. Whilst it is usual for spare parts to be cheaper from third parties, it can take longer to source them: a situation that plays into the hands of the OEMs when loss of generation revenue needs to be accounted for.

2.1.2 Independent service providers

Traditionally, OEMs have held the lion's share of O&M contracts; however, with a growing number of wind farms now coming to the end of their original warranties, there are increasing opportunities for ISPs to capture a chunk of this market. From the operator's point of view, ISPs may be able to offer a broader range of potential solutions compared with OEMs, as they are not tied to one vendor. That said, this might come at the cost of slower access to critical components, and a lack of specialized support in some cases.

These third-party organizations compete with OEMs, offering an alternative approach and greater flexibility, in particular for operators with a portfolio of turbines from different manufacturers. In some cases, ISPs are happy to offer a partial service; for example, leaving certain O&M aspects to the wind farm operator who can handle them more cost-effectively in-house. Such a hybrid arrangement might work by outsourcing scheduled maintenance, and keeping unscheduled maintenance tasks in-house when getting hold of contractors at short notice could be a challenge. Alternatively, outsourcing may be limited to large projects that require heavy plant or specialist skills not available within the operator's organization.

In the WEU Onshore O&M Survey, all ISP respondents were asked about which O&M strategies their service was most commonly deployed in. The results (Figure 8) show a fairly even split between the various approaches, with 29% each for reactive and predictive O&M, and 42% for preventative O&M strategies. This is a similar split to the operator responses detailed earlier in the report.

Services from ISPs can hold a number of advantages over extended OEM contracts (WorleyParsons, 2013):