Lifetime extension: making full use of installed capacity

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Decision-makers in the wind-energy industry are faced with a choice of three options when their wind energy converters (WECs) approach the end of their design life: they can either dismantle, repower or continue the operation of their WECs. In many cases, available lifetime reserves allow cost-effective continued operation. TÜV SÜD explains how to prepare the expert report needed for lifetime extension quickly and easily.

After 20 years, the design life of most wind-energy converters (WECs) is nearing its end. In terms of both sustainability and economic efficiency, it may be worthwhile t commission expert determination of the lifetime reserves of the WECs and continue their operation for a limited period before repowering or dismantling them. Continued operation can make good sense for logistical reasons, particularly where large numbers of installations and wind farms are involved. This applies especially to cases where repowering is not an option and the power generated by the WECs brings in at least the operating costs. When choosing this option, decision-makers must consider safety-related, legal and economic aspects. TÜV SÜD recommends acting early before expiry of the design life if possible.

The expert report

Working with manufacturers, operators, authorised experts, authorities and lawyers, the German Wind Energy Association (BWE) drew up Basic Principles for Performing an Assessment and Verification of the Lifetime Extension of Onshore Wind Energy Converters (LTE). These principles define the requirements for safe continued operation. They provide information about lifetime reserves and the necessary maintenance measures. LTE is also used to furnish proof of qualification to the competent licensing authority. The normative or regulatory requirements are set forth in the IEC 61400-1 and the DNVGL-ST-0262 standards. The starting-point of LTE is the original design conditions.

The goal is to determine possible load reserves. To do so, LTE uses as-is analysis and comparisons with the site-related conditions in the past service phase. The assessment covers two parts, a theoretical analysis and a practical inspection. The analysis consists of computer-aided modelling of the theoretical lifetime. For this purpose, the loads resulting from design wind conditions are compared to those that stem from simulations with site conditions. The basis of calculation is the WEC design as documented in the type certificate. Weather and performance data, technical documentation, servicing, maintenance and test protocols all contribute to providing a detailed picture of the wind farm's service history.

This alone is generally enough to reveal reserves in design loads, as designs are generally on the conservative side. In other words, many WECs are designed for higher loads than those to which they are actually exposed during service. The design of the installation itself also provides information of how its lifetime could be extended by replacing individual components, for example, or introducing dedicated monitoring measures. This may apply in cases where an essential role in operational safety is played by individual mechanical components with lifetimes known to be significantly shorter than that of the installation as such.

Parallel to theoretical analysis, the WEC is inspected in practice: in addition to regular periodic inspections, the experts perform in-depth on-site inspection of the load-absorbing and safety-relevant components of the WEC. To do so, the experts inspect the entire installation from its foundation to its rotor blades. Safety equipment, control systems and brake systems too are put through their paces. Based on their long experience, the experts focus on aspects and weak points typically prone to defects. Some design-related issues, for example, are characteristic of specific types of installation. The results of the analytical expert opinion provide further indications that can be addressed in the on-site inspection.

The experts also take possible changes in the environment of the WEC into account. In particular, structural measures on adjacent installations or wind-farm

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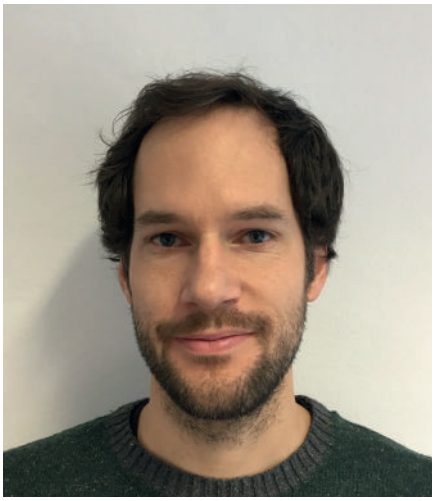

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extension may significantly impact on wind conditions and must be considered in the determination of turbulence.

Assessment of clusters instead of individual WECs

As individual inspection of each WEC may prove inefficient for larger wind farms, TÜV SÜD has developed a solution for the wind-energy industry. Provided the conditions at a site are homogeneous throughout the service life, cluster assessment will help to save time and costs. It will provide wind-farm managers seeking to continue operation of their existing WECs over a defined limited period, e. g. until full repowering, with clear information about which WEC types need to be taken out of service and when, and what measures will be necessary in order to continue their safe operation up to that date. This makes planning of the modernisation, or if necessary, also dismantling, of a wind farm more predictable in terms of both finances and logistics. Only in cases in which maximum lifetime extension needs to be determined do individual assessments frequently make good sense.

Another benefit is that the method developed by TÜV SÜD is largely automated, which also saves time. Reports can be available in only four weeks. While computer simulations and load calculations make use of established wind-industry software, TÜV SÜD uses an app specifically developed in-house for on-site documentation. The app processes the data entered and automatically generates a comprehensive, standardised and easy-to-read test report from a single source. The expert report facilitates the licensing process, ensures cost transparency and provides managers with planning certainty.

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Starting on time

LTE should be implemented in the last regular year of operation. The responsibility for commissioning the assessment and verification on time and for providing the necessary information and documents rests with the wind farm managers. In addition to the WEC approval and the construction- and commissioning-related documentation, this includes all data related to operation and yield, maintenance, repair and test reports as well as wiring and hydraulic diagrams.

Further important data are the wind conditions in the past phase of operation. Only if mean wind speed, extreme wind events or turbulence intensities are known and quantifiable are the experts able to calculate the loads acting on a WEC during this period. This information can be derived from the turbine operating data and the data recorded by the anemometer mounted on the nacelle. If the data are incomplete, further data records such as re-analysis data are used for long-term extrapolation. In the case of WECs located in wind farms that involve multiple extension scenarios, turbulences are calculated separately for each wind-farm condition.

The odds are good

Lifetime extension is a particularly wise option if profitability has been ensured on the basis of a conclusive marketing concept and repowering is impossible – for example, because of new regulations concerning minimum distances, or because a site has been converted into a conservation area. If the WEC has been regularly inspected, serviced and maintained, the odds of a positive report are good. This applies all the more to small- and medium-sized wind farms which have not been exposed to extreme weather events. Instead of commissioning


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individual reports for each WEC or even individual components, possibly even from various service providers, wind-farm managers who opt for having all their existing WECs inspected and assessed together will benefit from synergy effects.

Experience shows that in most cases, continued operation can be realised with only minor efforts. Before a component is replaced, the experts check whether regular monitoring might also be a solution or whether replacement of specific parts may be sufficient. Worn cables and surface defects caused by inclement weather, such as corrosion or flaking protective coating, also can be repaired easily.


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What is important is that managers commission the expert report at an early stage, in other words at least six, or even better, 12 months before expiry of the design life to facilitate the process, for example by scheduling the on-site inspection in the low-wind season. On the basis of LTE, managers can calculate the costs of servicing and maintenance during the residual lifetime more precisely and develop improved maintenance solutions. As a rule, the LTE report is also imperative for the renewal of insurances and for collaboration with service providers. In dealings with approval authorities the report can be used as proof of qualification.

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