

Life Extension Program

Gamesa Services



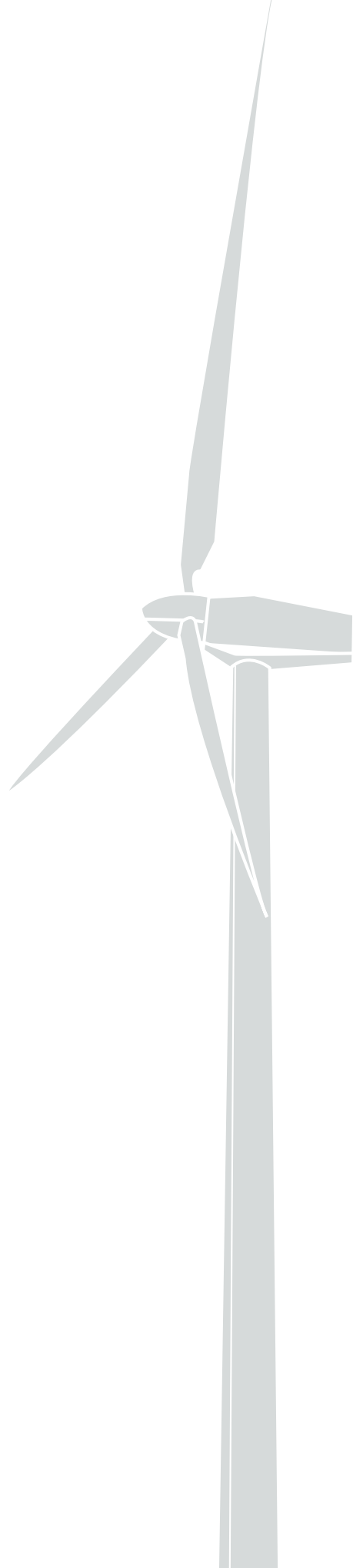
GLOBAL TECHNOLOGY
EVERLASTING ENERGY

Gamesa



INDEX

- p.4** How can wind energy keep pace with the announced 30% reduction of the CoE?
- p.5** What about the other platforms?
- p.6** Why extend the operational life of the fleet?
- p.7** Why is life extension now possible?
- p.9** Reliability-centered maintenance.
- p.10** Reconditioning of major components.
- p.12** A new gearbox for old turbines.
- p.14** Condition monitoring expertise.
Certification.
- p.15** Is life extension possible for all existing turbines?
Conclusion.



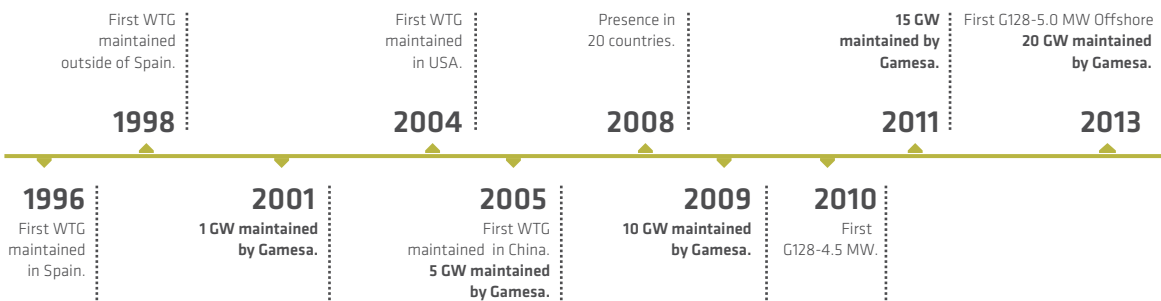
Introduction

With 20 years' experience, Gamesa is a global technological leader in the wind industry.

Its comprehensive response includes the design, manufacturing, installation and maintenance of wind turbines, with more than 28,800 MW installed and 20,000 MW under maintenance across more than 30 countries. Gamesa currently delivers high quality O&M services for more than 180 customers with one of the best health & safety records (ensuring that the customers become a point of reference within the wind energy industry).

Operations and Maintenance is one of the key areas of growth for Gamesa. The company works intensively on cost reduction programs, production output maximization and availability improvements (up to 30% reduction in energy cost within the next 5 years) for not only new, but existing turbines as well.

Thanks to its technical and organizational expertise, Gamesa proposes a full range of solutions to maximize profitability, such as extending the operational life of obsolete platforms such as the G47 model.



*Data as of 31st. Dec. 2013

How can wind energy keep pace with the announced 30% reduction of the CoE?

While all manufacturers have increased rotor sizes and improved the efficiency of their turbines to harvest the maximum amount of energy from any given wind, new alternatives such as reliability-centered maintenance and reconditioning programs play an ever increasingly important role. However, these improvements are just the first glimpse of a much more ambitious and promising opportunity: turbine life extension.

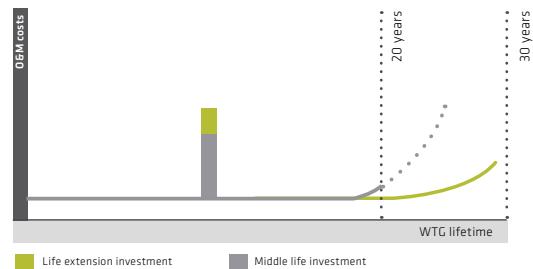
This program consists of audits, and preventive and corrective upgrades, implemented only when absolutely necessary, which improve the design of critical components with the latest state-of-the-art technology.

THE MAIN, MOST IMMEDIATE BENEFITS FOR THE CUSTOMERS ARE:

- ▶ 10 additional years of income that will be maintained in the long-term through an availability guarantee.
- ▶ More reliable turbines that are easier to maintain, keeping O&M costs low.

BESIDES THESE OBVIOUS ADVANTAGES, GAMESA CAN PROPOSE:

- ▶ A long term & full service O&M contract to guarantee that operational costs are stabilized at the level generally incurred on a 10-year-old wind farm.
- ▶ A tailored investment & financing plan, based on technical audits of individual turbines, with the aim of achieving optimized cash flow for Gamesa's customers.





What about the other platforms?

The extension of service life is an ongoing monitoring & upgrade program that could be applied to most existing turbines.

As Gamesa Services has already accumulated more than 15 years experience (105 million operations' hours) with the Gamesa 660 kW platform, Gamesa has the operational experience and technical expertise to

provide the high-level technological solutions needed by its customers.

In 2013, Gamesa launched a similar program for the Gamesa 850 kW and 2.0-2.5 MW platforms, on which it has already accumulated a total of more than 200 million hours in maintenance experience.



Why extend the operational life of the fleet?

Although most wind farms are not 20 years old yet, many clients anticipate the future of their assets will be affected by rising O&M costs. In some cases older wind turbine design and siting was undertaken according to guidelines and state-of-the-art wind energy technology from the 1990s. While these machines were certified by the standards in force at the time, experience and research have led to more accurate models and newer standards. As a result, if the current criteria were used, these machines would be classified in a different type class, likely one subject to higher loads, than that originally assigned.

The service life of some of the wind turbine's main components such as gearboxes, frames and blades were the first to be affected. Fatigue failures can damage some parts of the structure leading to, in some cases, a sudden collapse of the machine. These increasing failures jeopardize the original business case as the potential solutions are costly and are not covered either by manufacturer's warranties or customers' insurance.

Depending on the case of each turbine, customers could choose between decommissioning the machine(s),

dismantling them, or replacing them with larger / newer equipment. However due to financial constraints, and technical and legal impediments, these two options are economically unfeasible for most.

Currently, more than 70,000 MW in the world have been running for more than 5 years. The real challenge exists in upgrading these turbines to make the wind farms profitable beyond their original useful lifetime, without the need for any subsidies.

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Why is life extension now possible?

In the last 15 years the whole industry has drastically increased its technical know-how and operational experience, now making a longer operation lifetime possible.

IMPROVED AERO ELASTIC MODELS

Certifying agencies validate manufacturers' turbine designs ensuring that security margins are sufficient to bear loads during the entire original useful lifetime of 20 years. Years of operational experience have provided the necessary know-how to improve mathematical models in order to simulate the evolution of turbine structural elements (frame & tower) over the long term. Those simulations demonstrated that Gamesa applied security margins are compatible with an extension to 30 years of operational life.

EASIER ACCESS TO REAL AND USEFUL DATA FROM THE FIELD

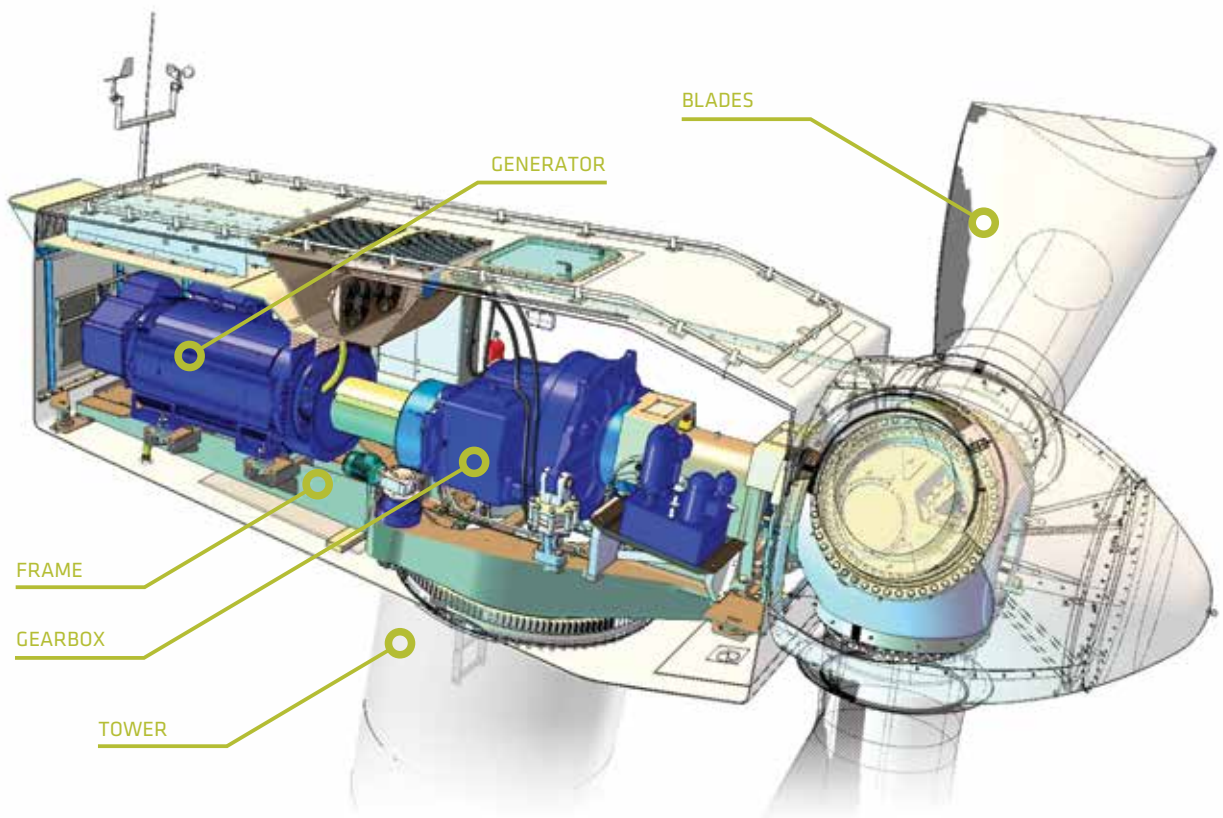
Condition monitoring has been used for many years in power plants and industrial facilities. At the beginning,

it was rarely used in wind turbines due to skepticism surrounding its advantages for end-customers, and even today it is seen as a plus for onshore turbines. However, some manufacturers use the continuous and critical data from CMS to improve the design of existing main components (reconditioning), and to design new gearboxes and blades for out-of-production turbines, such as the G47.

CREDIT CRUNCH

Only 5 years ago, very few people in the wind industry apart from Gamesa believed in the life extension program, as the entire market was favoring repowering instead. As turbine nominal power increased quickly and financing was not an issue, most of the manufacturers planned to replace the oldest turbines with new ones. However, with the recent and long-lasting credit crunch the industry faces, many customers are not willing to take such a risk. For turbines with nominal power of above 500 kW, maximizing existing investments at the lowest cost and with complete security is the most appropriate solution, until the turmoil comes to an end.





Reliability-centered maintenance

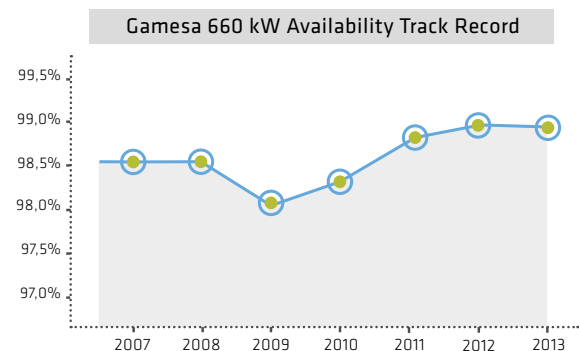
As a completely vertically integrated manufacturer which maintains more than 80% of its turbines, Gamesa brings in-depth and extensive know-how. Thanks to this experience, Gamesa can transfer the latest design improvements to the existing fleet, making these machines more reliable and easier to maintain.

One process being used successfully by Gamesa to achieve this aim is the reliability-centered maintenance (RCM). RCM is a process that has been used for more than 50 years in other industrial sectors such as nuclear, aeronautics, rail and aerospace. It involves studying the failure modes of each component and the possible consequences of their failure on a more complex system. RCM optimizes maintenance tasks, defining predictive, preventive and corrective actions, and finally determining when a component should be upgraded with the latest state of the art design.

Bottom line; rather than just replacing a broken turbine component with the same component, that could fail again, RCM is a dynamic process that configures each maintenance program based on the evolution of the wind turbine, and on the point of its life cycle reached. This guarantees optimized maintenance and allows an

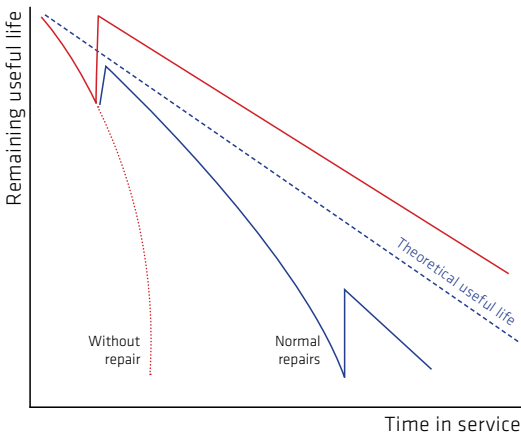
extension of the original useful life by identifying where it's possible to make hardware or software upgrades, with the goal of making the turbine more reliable or easier to maintain.

For example; Gamesa developed a full range of upgrades, such as the reconditioning of major components, to improve G47-660 kW productivity and stabilize running costs at levels incurred on a 10-year-old wind farm. This achieves more than 98.5% availability on the 1,804 turbines of the Gamesa 660 kW platform maintained by Gamesa under long-term full service contracts.



Reconditioning of major components

The reconditioning of major components performed by Gamesa involves extending the useful life of blades, gearboxes, and generators, mainly by enhancing their constituent parts or by replacing these elements with the latest technological advances. In some cases, as a preventive measure, or during repairs, the damaged parts are replaced with the same original element. As we subject the component to bench tests at full load, taking it to its operational limits, Gamesa guarantees an extended useful life, which enhances the turbine's performance while reducing risk and O&M costs for the client.



As an example, Gamesa can recondition more than 90 different component models used in turbines from the original manufacturers.

During reconditioning, Gamesa does not replace all the components subject to wear, and which were designed to last 20 years. As a consequence, using reconditioned gearboxes does not allow the turbine's operational life to be extended to 30 years, without one or even two large corrective maintenance tasks. To address this issue, for the last three years Gamesa has been manufacturing a completely new and reinforced gearbox, with the latest state-of-the-art design, for the oldest and out-of-production turbines.

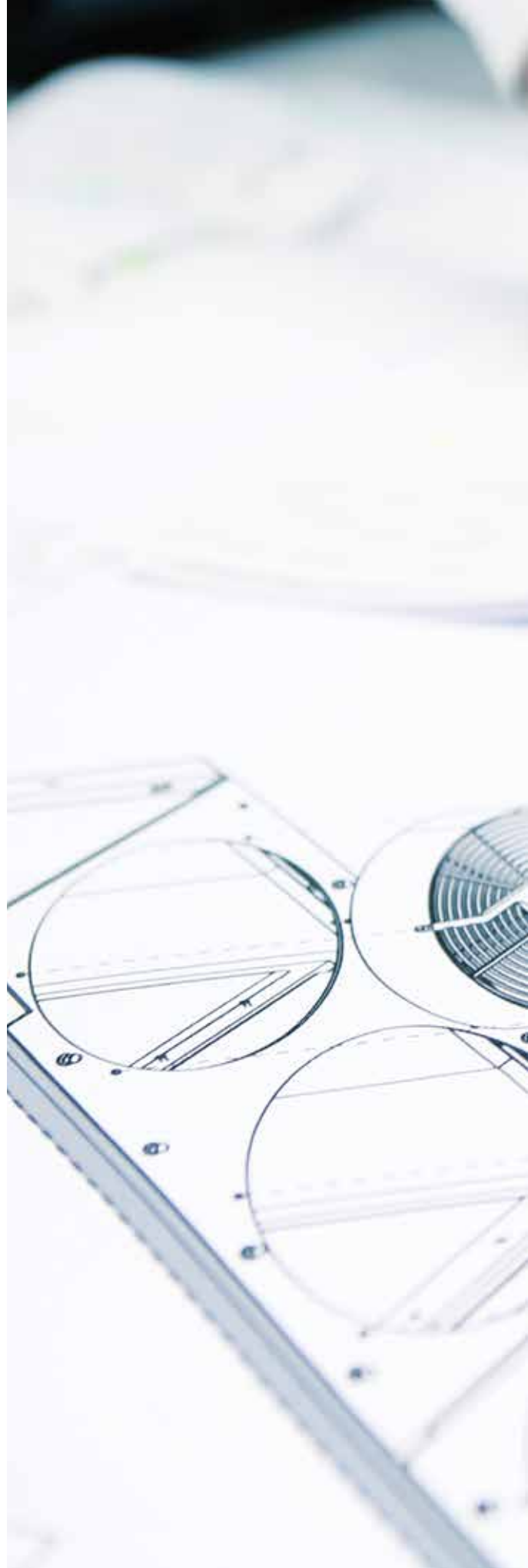
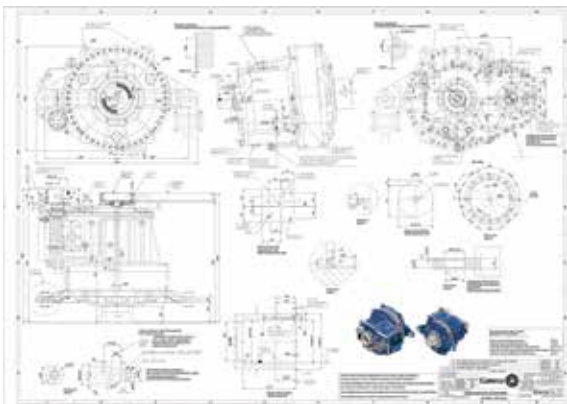
The useful life extension program involves investing in preventive and corrective activities -only when it is really necessary- to keep wind turbines working for 30 years, so an immediate replacement of the existing components is not required. When large components do fail, Gamesa will propose the installation of a reconditioned one or even the new GE700PL model instead of repairing the original ones.

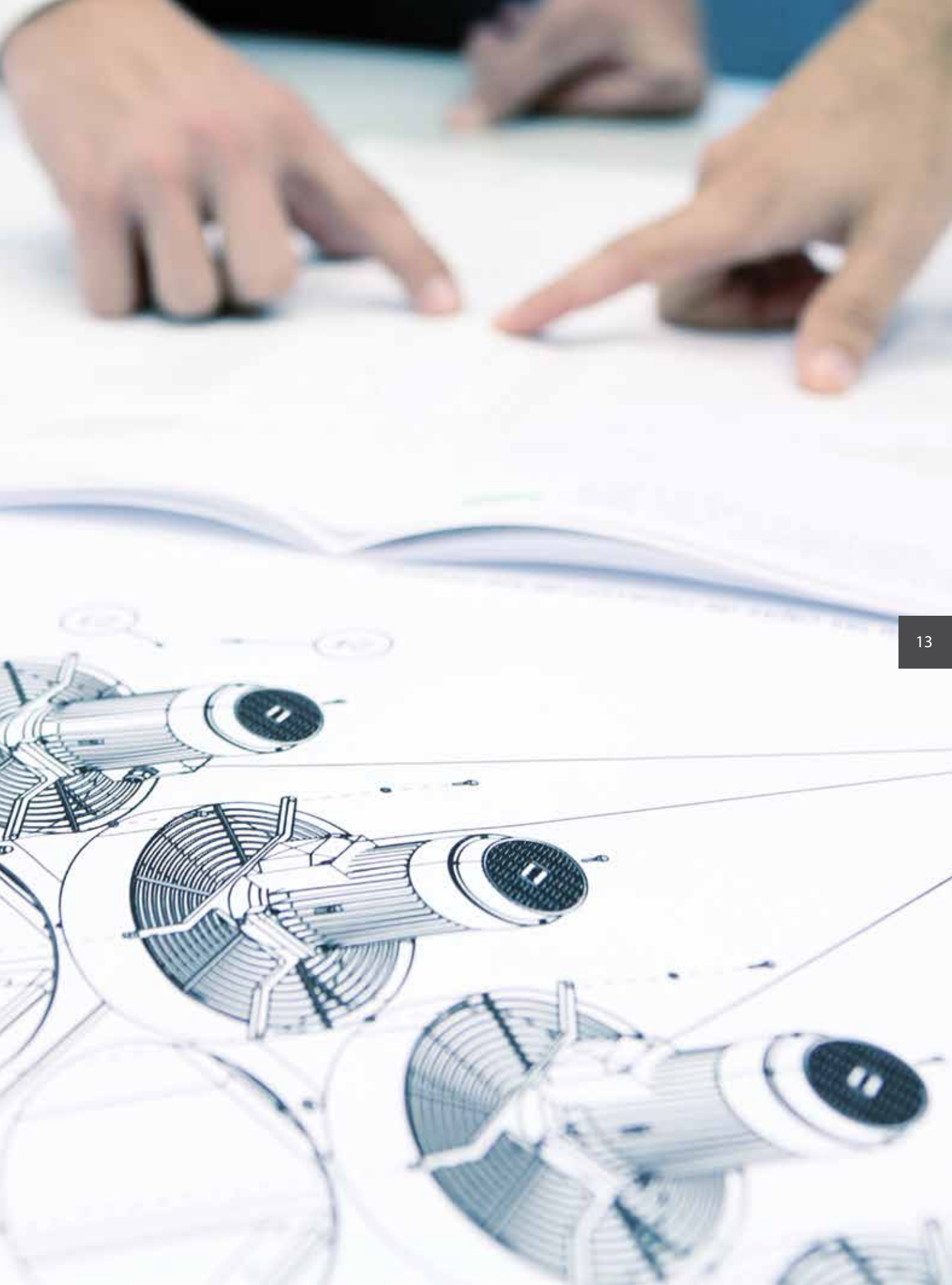


A new gearbox for old turbines

The GE700PL is a new gearbox based on the Gamesa's 850 kW platform that has been recognized as one of the most reliable on the market and to which Gamesa incorporated the latest design enhancements. Considering that gearbox manufacturing costs have fallen sharply in the last 5 years, an oversized gearbox that could bear more than 20 years of operations is the best economical choice to keep running costs at the level of the 10 year mark.

Reducing the mean time between failures might be important, but it's still not enough. The productivity of a wind farm can be impacted by a wind turbine's downtime that will stem mainly from an unscheduled component failure. The Gamesa's enhanced Condition Monitoring System will not only monitor the main components but also the structural elements of the turbine to solve the problem.







Condition monitoring expertise

Although Condition Monitoring is often seen as a plus for onshore turbines, Gamesa does use the continuous and critical data for Structural Health Monitoring System, anticipating risks in the structures. As the wind farm ages, and particularly during the proposed extended life period, this guarantees safe operating conditions, both for the structure and for the operator.

This monitoring is all the more critical as preventive interventions and upgrades cost on average 80% less than corrective actions. This statistic is based on Gamesa's current experience gained on turbines already upgraded with solutions fully validated on the test bench and on site.

Certification

Because Gamesa upgrades do not modify the turbines' characteristics, there is no need for re-certification to meet regulations and operate turbines beyond their original service life. Nevertheless, Gamesa is in the process of being certified by DNV GL for the Life Extension product and will support customers if local authorities request any reports from the original manufacturer. These reports will demonstrate that extending wind turbine operation beyond the original service life will not generate any additional risks (Health & Safety, environment, grid integration, etc.).

Due to its knowledge and work on developing solutions for wind turbines life extension, Gamesa has also been appointed to the advisory board of the SafeLife-X Project. The progress in this area has led the company to be invited to represent the wind energy sector in this committee. SafeLife-X is an European Union-sponsored project set up to develop effective solutions during the next ten years (2015-2025) for minimizing the aging of industrial infrastructures and facilities and guaranteeing their safety.

Is life extension possible for all existing turbines?

It is feasible to extend the life of most wind turbines, and original manufacturers are one of the key stakeholders in the process.

First, the original manufacturer must still exist, as it would be very difficult for any third party to develop a comprehensive solution that would drive the turbines up to 30 or even 35 years of operational life.

Secondly, in order to develop cutting edge solutions, the original manufacturers must have the appropriate resources: R&D, operational experience, investment capacities, etc.

Then, the company must also have an adapted service strategy and strong operational experience to be able to propose Full Scope O&M contracts for the next 15 years of operations.

Finally, the original manufacturer must have the capability to supply, at a reasonable price, all spare parts for the 30 years of operation. From this perspective, manufacturers that maintain a substantial part of their oldest turbines will have the adapted supply chain to guarantee it. As a matter of fact, Gamesa proposes life extension solutions for its platforms and for turbines designed by other manufacturers.

CONCLUSION

Apart from representing a unique business opportunity considering the existing financial & legal constraints, the cutting-edge life extension solutions represent a minor risk investment considering that Gamesa has the necessary operational experience and technical expertise, and has already performed turbine upgrades. This proven capability will back up our customers' decision to modify their accounting rules, making them more profitable in an uncertain global economy.

As the investment in preventive and corrective actions, only when absolutely necessary, will be planned based on individual turbine technical audits, Gamesa's tailored financing plan will guarantee an optimized cash flow for customers over the long term. Additionally, all the customers' benefits, such as revenues and low running costs, will be supported by long-term and full-service O&M contracts which will include an availability warranty.

And last but not least, Gamesa's flexibility to adapt to customers' needs is part of our promise of providing maximum added value, helping our customers become a benchmark in the sustainable and low-carbon wind industry.

As all the key parameters are known - wind, turbine availability, O&M costs and price of energy - Life Extension represents a minor risk investment for Gamesa's customers.

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