



Wind energy in motion

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The wind energy industry has grown up. Sophisticated technologies and a tough market call for more than just a professional repair of faulty equipment.

Up to the medium power range it has become a commodity market where quality has become a given and where typical commodity linked drivers like timing and cost push the turbine manufacturers into continuous optimisation of the value chain.

In recent years, in the gearbox service market, we have seen a similar trend.

The general drive for lowest energy cost is

gaining momentum and demanding solutions.

Historically the service business has been closely linked to the new gearbox business of the large OEMs. For years the business required only one solution for servicing a gearbox and that was to bring it back in the best possible state. In practice, due to the learning curve and related upgrade, this means that a repaired gearbox is now

becoming even better than the original serial product.

The market is changing now and seeking significantly greater flexibility. This flexibility originates from the drive towards lowest cost of energy. Segmentation is taking place in the market and within every segment the customer has a different view about how he wants the gearbox to be repaired. Customers are asking for different repair levels. Depending on a number of parameters, including age, the required repair scope varies.

At the one end this could mean that a gearbox has to be refurbished almost to the

original new condition, or even upgraded to the latest enhanced status of the gearbox. At the other end, lowest possible repair cost is envisaged leading to the lowest possible repair scope.

Ultimately the required, remaining lifetime will drive the choice for the gearbox repair. This flexibility in repair levels however requires a complete different approach to servicing gear units. ZF Wind Power has a holistic approach to address these new requirements

ZF has created a dedicated service organisation

Traditionally serial business strongly focuses on streamlining its repetitive nature, doing the same thing according to state of the art quality and efficiency standards. Product offering, within a service environment, intrinsically represents much more variety, but now also different repair standards further increase complexity.

Specific structure and processes have been created and tailored to manage the diversity linked to the different repair standards. Processes have been set up in such a way that the increased complexity will not negatively impact on cost and lead time. The dedicated structure will also allow strong focus on the complete value chain and results in best in class cost and lead time efficiency.

Variety in repair offerings

The industry is already seeing multiple repair standards, but this was rather linked to the characteristics of the players concerned (OEM/ISP/Gearbox manufacturers). OEMs have traditionally maintained a very high standard. The

different repair standards originate from players trying to address the different market requirements.

Most companies are only capable of offering one single repair standard based on the characteristics of their setup. The challenge is to combine the market requirement in a structured way, leading to a consistent set of generic repair levels, without compromising the quality and lead time benchmark.

Engineering know-how of the installed base and gearboxes is required for correct component assessment and rework technologies in order to reach lowest possible repair cost for each generic repair level.

ZF Wind Power is co-operating with the customer to leverage all this know-how and define customer specific set up for tailored repair needs.

Repair levels

From a design perspective, generic repair levels are derived from the historically grown, previous repair standard. In the old standard basic principles of replacement, rework or re-use were based on a lowest possible risk and maximum remaining lifetime.

Vast engineering know-how is required to balance that risk in alignment with a required remaining lifetime. This is done by rethinking all parameters that determine the rebuild condition of the gearbox and the resulting performance and life expectation.

These parameters are linked to the condition of the gear unit components and include allowed tolerances, damage, wear

signs on critical, cyclic loaded components under which castings, gears, shaft and bearings will be assessed according to guidelines that correspond to the related, generic repair level.

The concept of donor parts will enable further cost reduction as it allows re-usable parts from a scrap unit, to see further life in a different repairable gear unit.

From the process perspective too, many repair level tailored measures are foreseen. Gearbox restoration is a labour intensive process and serial business standards under which painting, load testing, but also full disassembly are considered.

Repair specific technologies on a component level such as regrind, thermal welding, super-finishing are considered in their applicability to a certain repair level to further reduce cost.

Basically, three different repair levels can be distinguished. Nevertheless customer demands can always be translated into variants of the latter.

The premium repair level is the highest level within the repair standard. It has the most extensive repair scope and incorporates all available upgrades. Bearings are per definition replaced and components are only reworked/re-used if they can near new state tolerances and integrity.

Process steps like testing and painting are performed according to the serial business standard. The labour intensive disassembly step is done fully to achieve new gearbox cleanliness level.

Taking into account the robustness increasing upgrades, the premium repair





level offers a gearbox that has at least the lifetime expectancy of a new gearbox.

The standard repair level has a higher cost focus and differentiates from the premium repair as it does not target the lifetime of a new gearbox. Having also the most important upgrades, the gearbox will be brought up to a standard where it will easily surpass the required remaining lifetime.

It mainly differentiates from the premium repair in the assessment of the individual components. Acceptance criteria for the components are lower and balanced against minimal risk increase. More components will be re-used or re-worked resulting in a lowered cost.

The basic repair level focuses on the right balance between cost, remaining life expectancy and risk. Hereby all cost drivers are challenged on their value contribution at this repair level. The main goal of a repair here is to restore functionality at the lowest possible cost.

The gear unit is only disassembled to the level needed to repair the failed portion. Critical components, including bearings, are only replaced if failed or at risk of damage. Painting and testing is limited to the minimum, ensuring proper functioning. A basic repair delivers a gearbox that can

last still for many years against an acceptable risk increase.

New evolution in gearbox service

As a further evolution in service ZF Wind Power sees an important role for connected devices to actively control gearbox performance and health status during operation, as well as new methods to reduce service bills.

Gearbox performance measurements will open new possibilities relating to gearbox functioning and enable remote based engineering advice and uptower interventions preventing gearbox exchange.

Intelligent Performance Management systems will increase the proactive role of new service models in optimising wind turbine energy yield and allow power upgrades through active control thereby safeguarding gearbox lifetime and fine-tuning preventive maintenance intervals.

Smart systems will further reduce risk on the gearing and will optimise wind turbine performance with the main goal of reducing the cost of energy for wind power.

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ZF Wind Power

ZF's advanced technology solutions contribute to the transformation of the global energy system, in which reliable, robust and efficient products and systems conserve precious resources.

With combined expertise in automotive and industrial technology, ZF is determined to support its customers in making wind power the leading renewable energy source for the future. Sustainability lies at the heart of our endeavours.

With state of the art manufacturing plants and worldwide service locations, ZF is dedicated to delivering custom-built solutions and services on a global scale, meeting the individual needs of the global wind energy market.

Optimised service strategies - avoiding unnecessary downtime - are the key to reduce operational costs. As a continuous innovator, ZF anticipates the trend towards intelligent systems by enabling performance optimisation of the overall wind turbine. We are now moving forward with 'Intelligent Mechanical Systems'.