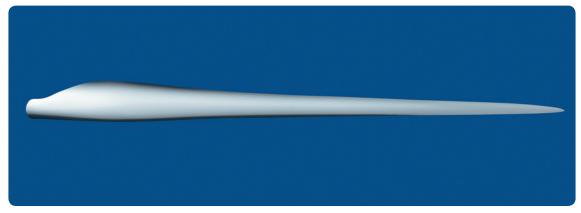
V90-3.0 MW

An efficient way to more power





Innovations in blade technology

3×44 metres of leading edge

In our quest to boost the efficiency of the V90, we made sweeping improvements to two aspects of our turbine blades: their material composition and their structure.

We at Vestas have long enjoyed a reputation for making some of the lightest blades on the market, and with the V90 we have once again raised the bar. We began by introducing several new lightweight materials, most notably carbon fibre for the load-bearing spars. Not only is carbon fibre intrinsically lighter than the fibre glass it replaces, but its strength and rigidity also reduce the quantity of material needed – thus cutting overall weight even further. So that even though the V90 has a swept area that is 27 per cent more than the V80, the new blades actually weigh about the same.

The new profile of the V90 blades also represents a significant aerodynamic advance. In collaboration with Risø National Laboratory in Denmark, Vestas engineers worked on optimising the relationship between the overall load impact on the turbine and the volume of energy generated annually. Their final blade design features an entirely new plane shape and a curved back edge.

The resulting airfoil improves energy production, while making the blade profile less sensitive to dirt on the leading edge and maintaining a favourable geometrical relationship between successive airfoil thicknesses. This translates into an increase in output combined with a decrease in load transfers – as well as improvements on the bottom line.

Reduced need for service and maintenance

A series of improvements to the V90 have made service and maintenance calls less demanding – and less frequent. Turbine access has been simplified and working areas expanded, while the arrangement of tower and nacelle components has been optimised to facilitate service procedures.

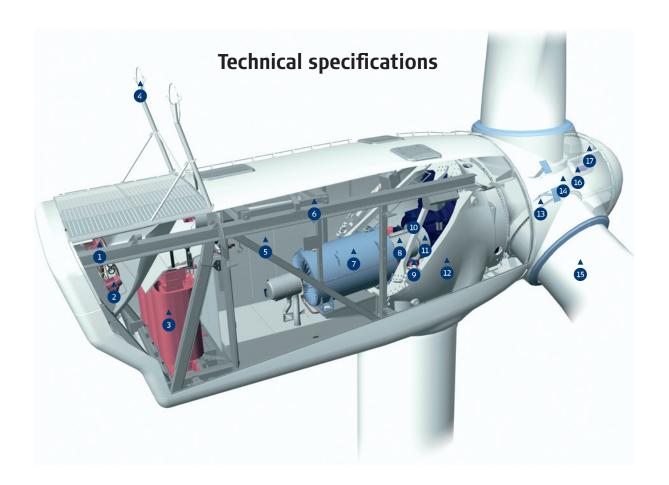
Moreover, a variety of new features, ranging from automatic blade-bearing lubrication to an oil-lubricated yaw system, have made it possible to reduce the number of preventive maintenance visits to one a year. This means considerable savings in turbine downtime and personnel costs, and is a particularly welcome development in the context of hard-to-reach offshore installations.

Proven Performance

Wind power plants require substantial investments, and the process can be very complex. To assist in the evaluation and purchasing process, Vestas has identified three factors that are critical to wind turbine quality: energy production, power quality and sound level.

We spend months testing and documenting these performance areas for all Vestas turbines. When we are finally satisfied, we ask an independent testing organisation to verify the results – a practice we call Proven Performance. At Vestas we do not just talk about quality. We prove it.







- 2 Water cooler for generator
- 3 High voltage transformer
- 4 Ultrasonic wind sensors
- 5 VMP-Top controller with converter

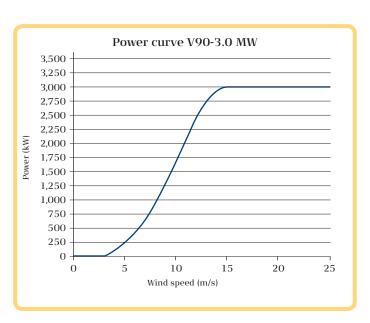
- 6 Service crane
- 7 OptiSpeed® generator
- 8 Composite disc coupling
- 9 Yaw gears
- 10 Gearbox

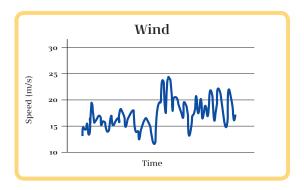
Mechanical disc brake

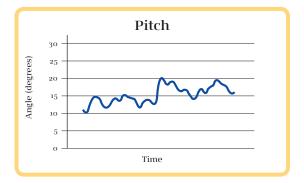
16 Pitch cylinder

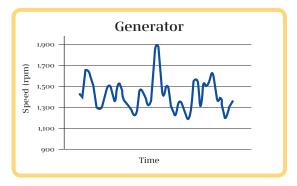
11) Hub controller

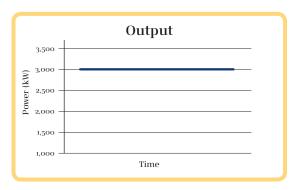
- 12 Machine foundation
- 13 Blade bearing
- 14 Blade hub
- 15 Blade











OptiSpeed® allows the rotor speed to vary within a range of approximately 60 per cent in relation to nominal rpm. Thus with OptiSpeed®, the rotor speed can vary by as much as 30 per cent above and below synchronous speed. This minimises both unwanted fluctuations in the output to the grid supply and the loads on the vital parts of the construction.

Rotor

Diameter: 90 m Area swept: 6,362 m² Nominal revolutions: 16,1 rpm Operational interval: 8.6-18.4 rpm

Number of blades:

Power regulation: Pitch/OptiSpeed®

Full blade pitch by three separate Air brake:

hydraulic pitch cylinders.

Tower

Hub height: 80 m, 105 m

Operational data

Cut-in wind speed: 4 m/s 15 m/s Nominal wind speed: Cut-out wind speed: 25 m/s

Generator

Asynchronous with OptiSpeed® Type:

Rated output: 3,000 kW Operational data: 50 Hz

1,000 V

Gearbox

Туре: Two planetary and one helical stage

Control

Microprocessor-based control of all the Type:

turbine functions with the option of remote monitoring. Output regulation and optimisation via OptiSpeed® and OptiTip® pitch regulation.

Weight

70 t Nacelle: Rotor: 41 t

Towers:

IEC IA IEC IIA DIBt III Hub height: DIBt II 80 m 160 t 160 t 105 m 285 t 235 t

 $t = metric\ tonnes.$

DIB towers are only approved for Germany.

All specifications subject to change without notice.

^{*}Vestas OptiSpeed® is not available in the USA and Canada.

An efficient way to more power



When Vestas set out to establish a new benchmark for efficiency with its development of the V90-3.0 MW turbine, high priority was given to keeping weight down. That is because wind turbines are heavy, and the heavier the turbine, the greater the costs – for production, material, transport and installation.

Our engineers therefore rethought every aspect of turbine design – from foundations to blade tip – seeking ways to minimise the cost per kWh over the design lifetime of the V90. The result is a showcase of innovative engineering – particularly as regards weight saved. In fact, despite a larger rotor and generator, the new V90 actually weighs less than the V80-2.0 MW.

The biggest reduction has come from strengthening the tower. To increase fatigue strength, we have pioneered the use of magnets to fasten internal components to the tower walls. In addition, using a stronger steel means less is needed. The decreased weight lets us construct the new towers in fewer sections, with significant savings in material, transport, and installation costs.

The most radical redesign centred on the new nacelle. Even though the 3 MW generator is 50 per cent larger than the corresponding generator in the 2 MW wind turbine, we kept overall nacelle weight almost the same. We did this by integrating the hub bedplate directly into the gearbox, eliminating the main shaft and thus shortening nacelle length. The result is a nacelle that can generate much more power without any appreciable increase in size, weight or tower load.

Together with new low-weight blades, these breakthroughs have made the V90 remarkably light for a turbine of its size – and remarkably efficient for a turbine of any dimension.

Vestas Wind Systems A/S Alsvej 21 8900 Randers Denmark Tel. +45 97 30 00 00 Fax +45 97 30 00 01 vestas@vestas.com

To see a complete list of our sales and service units, visit www.vestas.com