

Vestas[®]

V112
3.0 MW
OFFSHORE

Wind. It means the world to us.[™]

V112-3.0 MW Offshore

Making offshore wind even more profitable

High output and a strong business case

The V112-3.0 MW Offshore is engineered to take full advantage of wind conditions at sea. Optimised for high offshore wind speeds and low turbulence, the V112-3.0 MW Offshore has achieved the IEC IB offshore wind classification.

Offering industry-leading reliability, serviceability and availability under offshore conditions, this unique offshore turbine is your low risk choice for IEC class IB offshore sites. It gives you the best possible return on your investment by maximising power production while minimising downtime and maintenance costs.

Reliable technology added new innovations

What's more, the V112-3.0 MW Offshore builds on the proven technology of previous Vestas turbines to deliver component reliability and durability. This reduces the risk of downtime and helps to ensure the stability of your investment. Due to the quality of our project engineering, logistics, construction and commissioning, we will deliver your wind turbines on time. In short, this game-changing platform is unmatched in its ability to maximise the return on your investment.

The V112-3.0 MW Offshore includes a number of new innovations, such as the power system. This features a permanent magnet generator to ensure wider operation range of the turbine and reduced loss of power, and a full-scale converter which provides excellent grid support, reduced drive-train loads and optimum energy production over a greater range of wind speeds.

Wind. It means the world to us.™
Wind is all we do. We are relentlessly committed to the success of wind as a source of energy for the world, providing everything you need to succeed in your wind power ambitions.



Your low risk choice
for IEC wind class IB
offshore sites

Industry-leading technology generates more **energy**

Optimise energy production

- Large rotor diameter
- Tailored to offshore conditions
- Excellent grid support

Reduce energy costs

- Low Balance of Plant (BOP), installation and transportation costs
- Designed with focus on safety and serviceability
- Innovative CoolerTop® uses the wind's own energy

Secure your investment

- Proven technology
- Reliable and robust product
- Uninterrupted control of wind energy production

Here's an overview of selected benefits and features that optimise your energy production, lower your operating costs and strengthen the business case for choosing the V112-3.0 MW Offshore.



54.65 M

The V112-3.0 MW Offshore sets completely new standards for production capacity at wind speeds below 12 m/s by adding impressive 54.65 m blades.

Large rotor diameter expands your production

The impressive 54.65 m blades set completely new standards, making it possible to produce more energy from the same available wind. The blades deliver a remarkable ratio of rotor size to generator capacity. The result is high yield even at low and medium wind speeds.

What's more, the profile of these 54.65 m blades is optimised both for aerodynamic efficiency and to ensure that their structural strength is increased. The shape of the blades also makes them less sensitive to dirt and other airborne materials, resulting in a better production performance at offshore sites affected by salt.

Perfectly equipped to offshore conditions

Tailored to offshore conditions

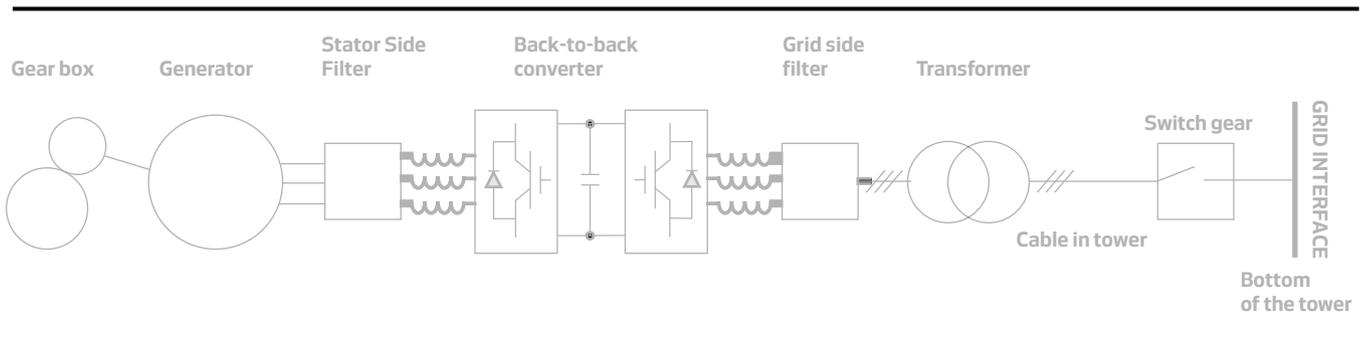
Offshore is in general a far more windy and hostile environment than onshore. The V112-3.0 MW Offshore is specifically tailored to these challenging conditions. To take full advantage of higher average offshore wind speeds, the rotor speed of the V112-3.0 MW Offshore is optimised to deliver the best balance between energy production and load.

Furthermore, the nacelle cover is incredibly robust and protects the internal components from the environment thanks to its ability to close the integrated air intake holes and service hatches.

Excellent grid support

The new power systems also accounts for the excellent grid support capabilities of the V112-3.0 MW Offshore, allowing it to meet a variety of demands worldwide. Having a permanent magnet generator and a full-scale converter makes it possible to fulfil the most advanced grid requirements on the market today.

The new power system has the capability to continue operating even when there is a severe grid voltage drop, and any excess power is converted to heat by a resistor in the full-scale converter without putting unnecessary load on the drive train components. In addition, the new power system is able to quickly down-rate to 20%.





THE NEW POWER SYSTEM

FULL GRID COMPLIANCE

Voltage range	0.9-1.1 pu
Frequency	47-53 Hz
FRT	Yes
Reactive power response	Yes
Max short-circuit level	25 kA

FEATURES

- Designed for superior grid support
 - Power factor range: 0.9 capacitive / 0.83 inductive (HV transformer)
 - Fast run back to 20%, spinning reserve 20% to 100%
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Reduce wind energy costs by design



Low Balance of Plant (BOP), installation and transportation costs

When it comes to logistics, no two offshore projects are identical. The V112-3.0 MW Offshore is designed for flexible and efficient transport and installation.

In terms of weight, height and width, all of its components comply with local and international limits for standard transportation, with no load weighing more than 70 tonnes.

At the dockside, the V112-3.0 MW Offshore is highly adaptable to different installation vessels and procedures, helping to cut project times and costs.

Vestas' proprietary blade gripper and blade stacking system ensure safe handling of the giant blades and promote optimal and rapid vessel loading.

Furthermore, the innovative power system is designed to provide excellent grid support and is highly adaptable for future technical requirements. It also enables substations to be simpler and therefore more cost-effective.

Designed with focus on safety and serviceability

At Vestas we take pride in our uncompromising approach to health, safety and the environment (HSE). Our target of a zero-harm work environment drives us to improve our products and systems continuously.

The V112-3.0 MW Offshore's new nacelle is ergonomically designed and maximises the internal space available (e.g. by integrating the power converter into the nacelle floor). This extra space also makes it safer and easier for maintenance crews to gain access – reducing the time and cost spent on servicing and therefore maximising uptime. The automatic lubrication of the yaw system, main bearing and generator delivers the triple benefit of increased reliability, reduced maintenance time and less frequent servicing. The V112-3.0 MW Offshore needs a scheduled service just once a year.

On offshore sites, every minute spent on maintenance is precious. The V112-3.0 MW Offshore's combination of reliability and maintainability maximises your returns.

CoolerTop®

- No power consumption for fans
- Based on proven technology from existing Vestas turbines

Permanent magnet generator and full scale converter

- Simple and effective power system with high efficiency and excellent fault ride through capabilities
- PM generator: designed by Vestas
- Reduced maintenance cost
- Highly adaptable for future requirements
- HCCBA bearings (High Capacity Bearing)

Drive train

- Based on proven gear technology
- Integrated rotor lock system to improve maintenance ability
- Best performing gear solutions (proven from the Vestas Performance & Diagnostic Center) implemented.

Blade

- Design based on our 44 m blades
- 55% larger swept area over V90-3.0 MW
- Large root diameter ($\Phi 2.6$ m) ensures blade bearing longevity
- Lightning receptors and internal grounding cable integrated
- Robust performing profiles less sensitive to dirt and salt

Pitch system

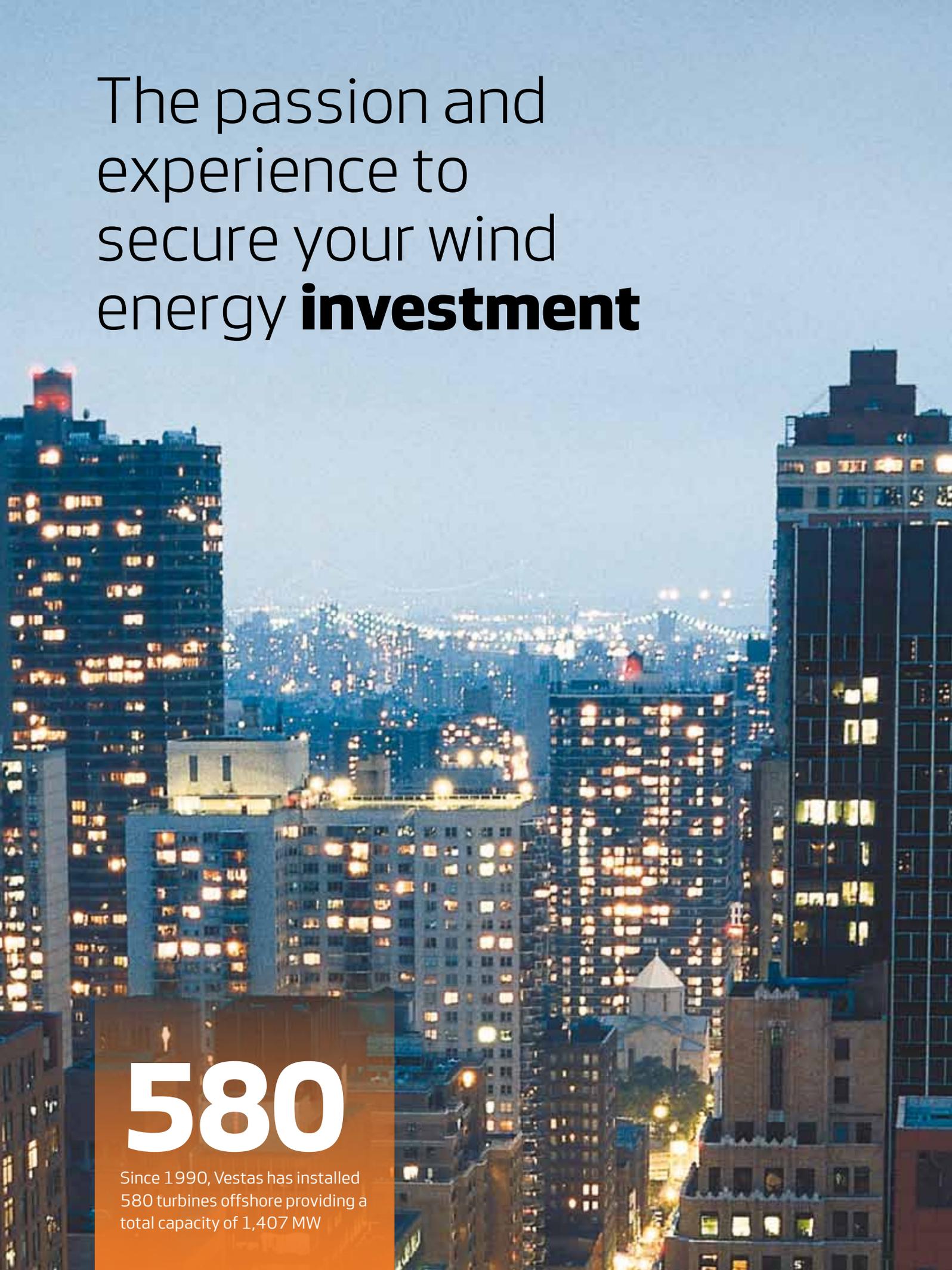
- Design based on V90-3.0 MW
- Double feeding pump system ensuring redundancy and reliability
- Solutions for safe work in hub integrated in design

Yaw system

- Design based on V90-3.0 MW and V90-2.0 MW
- 8 yaw gears
- Robust plain bearing with build in frictions (grease lubricated)

Innovative CoolerTop®

The signature CoolerTop® installed on the V112-3.0 MW Offshore uses the wind's own energy to generate the cooling required, rather than consuming energy generated elsewhere. The fact that the CoolerTop® has no moving parts means that it requires little maintenance, shaving costs once more.



The passion and
experience to
secure your wind
energy **investment**

580

Since 1990, Vestas has installed
580 turbines offshore providing a
total capacity of 1,407 MW

Life testing

The Vestas Test Centre has the unique ability to test complete nacelles using Highly Accelerated Life Testing (HALT). This rigorous testing of new components ensures the reliability of the V112-3.0 MW platform.



Proven technology from the company that proved it

Since 1999, Vestas has installed over 1,300 V90-3.0 MW turbines and more than 6,500 2 MW turbines globally. These workhorses form the basis of the mighty V112-3.0 MW Offshore, which incorporates their thoroughly tested technologies – including the pitch, yaw and control systems, and the drive train concepts. This heritage makes the V112-3.0 MW Offshore your low-risk choice.

The V112-3.0 MW Offshore is based upon the proven technologies that underpin the 40,000+ Vestas turbines installed around the world. Using the best features from across the range, as well as some of the industry's most stringently tested components and systems, this turbine's reliable design minimises downtime – helping to give you the best possible return on your investment.

Rigorous quality assurance, right from the start

The Vestas Test Centre is unrivalled in the wind industry and has the unique ability to test complete nacelles using Highly Accelerated Life Testing (HALT) to ensure reliability. At the critical component level, potential failure modes and mechanisms are identified, and rigorous design verification plans and procedures for testing and verification are made. Specialised test rigs are then used to ensure strength and robustness for the gearbox, generator, yaw and pitch system, lubrication system and accumulators.

The Vestas quality-control system ensures that each component is produced to validated design specifications, and performs at site. We also employ a Six Sigma philosophy and aim to perform at Six Sigma levels by 2011. We have identified the critical manufacturing processes (both in-house and for sub-suppliers), and we systematically monitor measurement trends that are critical to quality, to identify variation and make changes before any defects occur.

Uninterrupted control of wind energy production, at your **service**

VestasOnline® Business

Vestas wind turbines benefit from the latest Supervisory Control and Data Acquisition (SCADA) system for modern wind power plants: VestasOnline® Business.

This flexible system includes an extensive range of monitoring and management functions that allow you to control your wind power plant in the same way as a conventional power plant. VestasOnline® Business enables you to optimise production levels, monitor performance and produce detailed, tailored reports from anywhere in the world while the system's power plant controller provides active and reactive power regulation, power ramping and voltage control.

For every offshore wind project, we provide a service solution fully customised to meet the site's specific requirements. Thanks to our superior operations and maintenance capabilities, we also provide a level of service unparalleled in the industry.

Surveillance, maintenance and service

Vestas provides 24/7 monitoring, performance reporting and predictive maintenance systems to improve turbine uptime, production and availability. Operating a large wind power plant today calls for highly efficient management strategies, to ensure that power production is uninterrupted and that operational and maintenance expenses are controlled. The ability to predict when your critical components are most likely to break down is essential to this effort, as it helps to avoid costly emergency repairs and unscheduled interruptions to energy production.

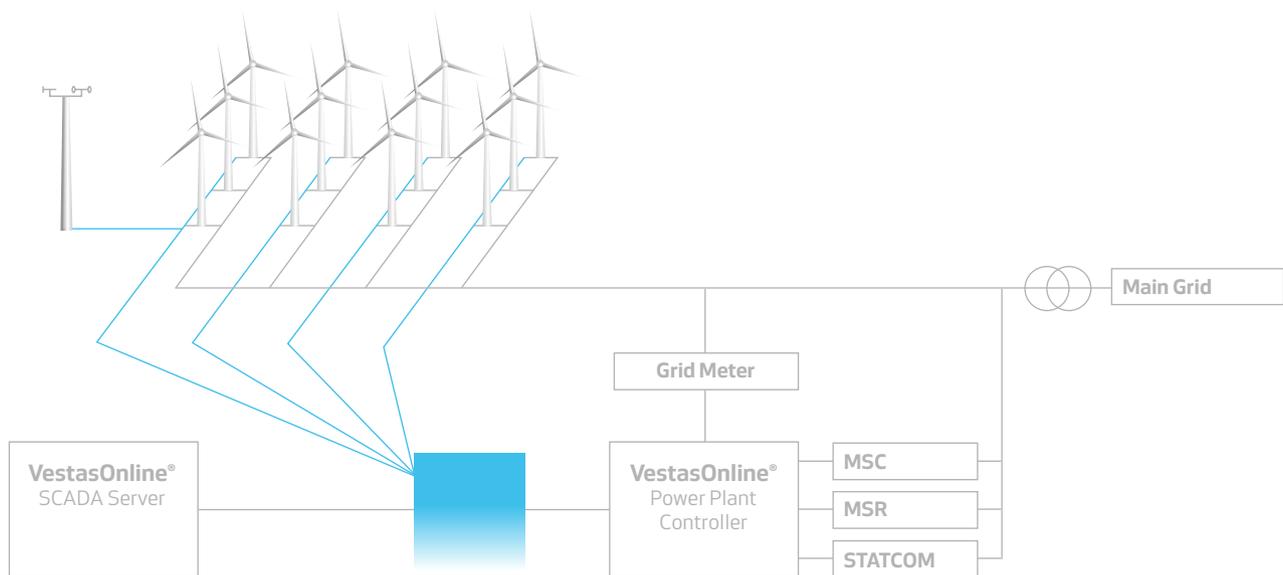
The Vestas Condition Monitoring System performs this predictive maintenance function, assessing the status of the V112-3.0 MW Offshore by analysing measured signals such as vibrations and temperatures (e.g. in gearbox bearings and the main bearings).

For example, by measuring the vibration of the drive train, the system can detect faults at an early stage and monitor the progress of the damage. This information allows the service organisation to plan and execute the required maintenance work before the component fails, reducing repair costs and production loss.

What's more, our Active Output Management® (AOM) concept provides detailed plans for service and maintenance, online monitoring, optimisation and troubleshooting, and includes a competitive insurance scheme. It is even possible to get a full availability guarantee, under which Vestas pays compensation if the turbine fails to meet the agreed availability targets.

VestasOnline®

This SCADA system turns a group of wind turbines into a wind power plant



Let our experience guide you

We have pioneered the offshore wind industry and installed around half the world's offshore wind turbines. You can count on our expertise in harnessing the raw power of offshore wind and transforming it into clean, reliable and predictable energy.

Today, we are the only global energy company focused purely on wind. To better meet the needs of our customers, we have brought together our vast wealth of offshore knowledge and expertise in a single business unit.

Vestas Offshore delivers superior turbine technology, convenient and cost-effective transport, fast and safe installation, and comprehensive service and maintenance. We have industry-leading experience in all aspects of offshore project management, from supply-only contracts to full-scale engineering, procurement and construction (EPC).

Above all, we specialise in providing our customers with maximum business case certainty and revenue predictability.

V112-3.0 MW Offshore

some impressive data

POWER REGULATION

pitch regulated with variable speed

OPERATING DATA

Rated power	3 MW
Cut-in wind speed	3 m/s
Rated wind speed	12.5 m/s
Cut-out wind speed	25 m/s
Re cut-in wind speed	23 m/s
Wind class IEC61400-3	IB
Operating temperature range	standard range: -20 °C to 35 °C

ROTOR

Rotor diameter	112 m
Swept area	9,852 m ²
Nominal revolutions	13.8 rpm
Operational interval	8.1 – 19.0 rpm
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Generator type	permanent magnet generator
Converter	full scale converter

GEARBOX

Type	4-stage planetary/helical
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TOWER

Type	tubular steel tower
Hub heights	site specific

BLADE DIMENSIONS

Length	54.65 m
Max. chord	4 m

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.8 m
Length	12.8 m
Width	4.0 m

HUB DIMENSIONS

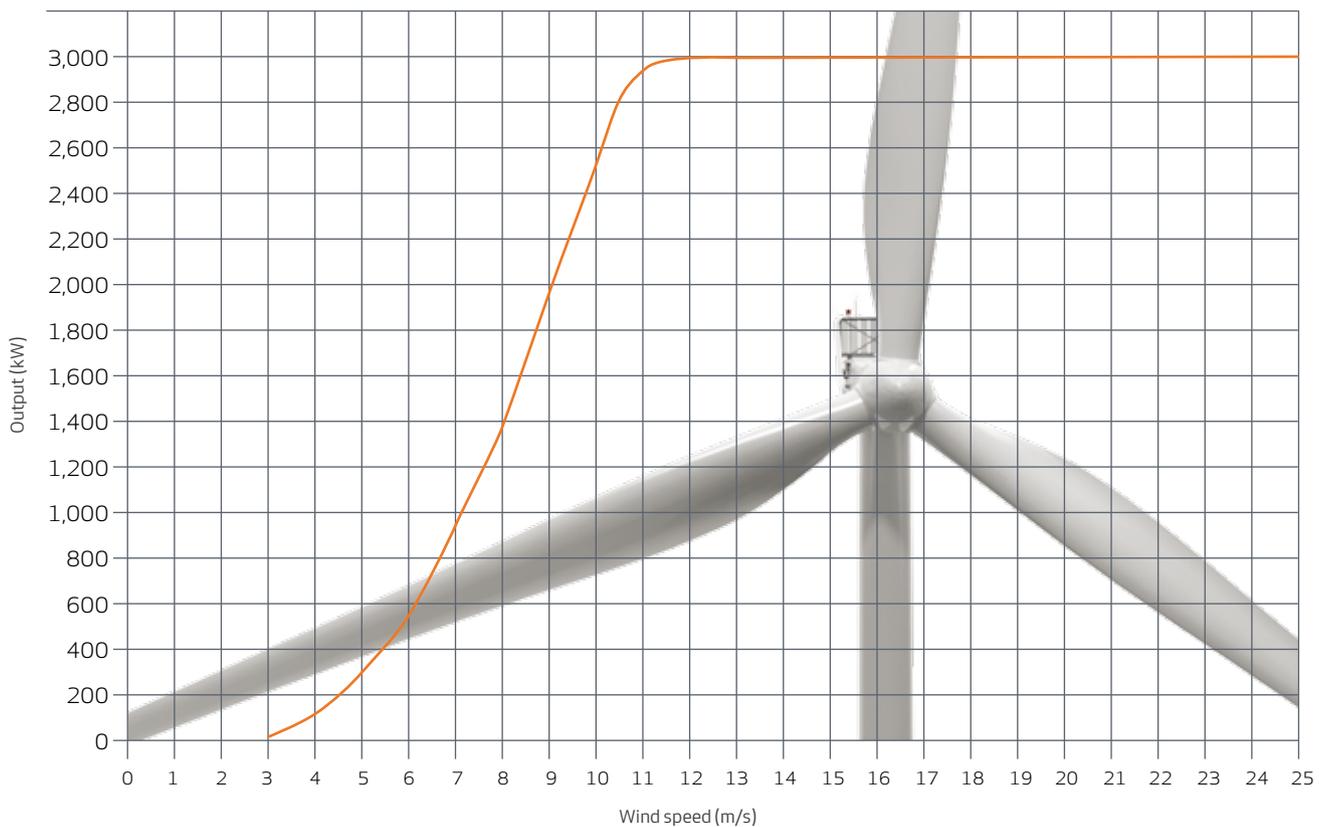
Max. transport height	3.74 m
Max. transport width	3.75 m
Max. transport length	5.42 m

Max. weight per unit for transportation	70 metric tonnes
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+20,000

Committed, highly-trained employees around the globe are always ready to help in any aspect of wind power production.

POWER CURVE FOR V112-3.0 MW OFFSHORE



ANNUAL ENERGY PRODUCTION (AEP)

8,5 m/s	13.402 MWh
9,0 m/s	14.311 MWh
9,5 m/s	15.119 MWh
10,0 m/s	15.826 MWh

Based on Weibull k parameter 2.0
and air density 1.225 kg/m³

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This product will not be available for delivery in the USA before spring 2011 and in Canada before spring 2012.