Attachment 1
Wind Turbine Brochures
When it comes to "megawatt-plus" technology, our proven 1.5 MW wind turbine continues to raise the bar. From ongoing technology investments in reliability and dependability, to more cost effective and versatile configurations, it need not rest on its past successes. Today, with over 3,300 units in operation worldwide, the 1.5 MW continues to be one of the world’s most widely used wind turbines in its class.

Active yaw and pitch regulated with power/torque control capability and an asynchronous generator, the 1.5 MW machine utilizes a bedplate drive train design where all nacelle components are joined on a common structure, providing exceptional durability. The generator and gearbox are supported by elastomeric elements to minimize noise emissions.
The 1.5 MW wind turbine also employs a variety of features inherent in GE’s full line of wind turbines which range from 1.5 to 3.6 MW, for both on and offshore use.

**GE’s Fleet-Wide Features and Benefits**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable Hub heights &amp; rotor diameters</td>
<td>Provides versatility/adaptability to a wide variety of project sites</td>
</tr>
<tr>
<td>Variable Speed Control and Advanced Blade Pitch</td>
<td>Enables aerodynamic efficiency and reduces loads to the drive train, thereby reducing maintenance cost and providing longer turbine life</td>
</tr>
<tr>
<td>WindVAR (optional) (Wind-Volt-Amp-Reactive “WindVAR”)</td>
<td>GE’s unique electronics provide transmission efficiencies and enable harmonious function within the local grid</td>
</tr>
<tr>
<td>Low Voltage Ride-Thru (optional)</td>
<td>Allows wind turbines to stay on line generating power, even during grid disturbances.</td>
</tr>
</tbody>
</table>

As one of the world’s leading wind turbine suppliers, GE Energy’s current product portfolio includes wind turbines with rated capacities ranging from 1,500 to 3,600 kilowatts and support services extending from development assistance to operation and maintenance. We currently design and produce wind turbines in Germany, Spain and the U.S.

Our facilities are registered to ISO 9001:2000. Our Quality Management System, which incorporates our rigorous Six Sigma methodologies, provides our customers with quality assurance backed by the strength of GE. We know that wind power will be an integral part of the world energy mix in this century and we are committed to helping our customers design and implement energy solutions for their unique energy needs. Every relationship we pursue bears our uncompromising commitment to quality and innovation.
Technical Data

Operating Data

<table>
<thead>
<tr>
<th></th>
<th>1.5s</th>
<th>1.5se</th>
<th>1.5sl (50Hz only)</th>
<th>1.5sle</th>
<th>1.5xle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated capacity</td>
<td>1,500 kW</td>
<td>1,500 kW</td>
<td>1,500 kW</td>
<td>1,500 kW</td>
<td>1,500 kW</td>
</tr>
<tr>
<td>Cut-in wind speed</td>
<td>6 m/s</td>
<td>4 m/s</td>
<td>3.5 m/s</td>
<td>3.5 m/s</td>
<td>3.5 m/s</td>
</tr>
<tr>
<td>Cut-out wind speed</td>
<td>25 m/s</td>
<td>25 m/s</td>
<td>20 m/s</td>
<td>25 m/s</td>
<td>20 m/s</td>
</tr>
<tr>
<td>Rated wind speed</td>
<td>13 m/s</td>
<td>13 m/s</td>
<td>14 m/s</td>
<td>14 m/s</td>
<td>12.5 m/s</td>
</tr>
<tr>
<td>Wind Class - IEC</td>
<td>IIa</td>
<td>Ib</td>
<td>–</td>
<td>IIa</td>
<td>IIIb, Nw(III) = 55 m/s</td>
</tr>
<tr>
<td>Wind Class - DIBT WZ</td>
<td>II/III</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>II</td>
</tr>
</tbody>
</table>

Rotor

<table>
<thead>
<tr>
<th></th>
<th>3</th>
<th>3</th>
<th>3</th>
<th>3</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of rotor blades</td>
<td>3</td>
<td>70,5 m</td>
<td>70,5 m</td>
<td>77 m</td>
<td>77 m</td>
</tr>
<tr>
<td>Rotor diameter</td>
<td>3</td>
<td>3904 m²</td>
<td>3904 m²</td>
<td>4657 m²</td>
<td>4657 m²</td>
</tr>
<tr>
<td>Rotor speed (variable)</td>
<td>12.0 – 22.2 rpm</td>
<td>12.0 – 22.2 rpm</td>
<td>11.0 – 20.4 rpm</td>
<td>11.0 – 20.4 rpm</td>
<td>10.1 – 18.7 rpm</td>
</tr>
</tbody>
</table>

Tower

<table>
<thead>
<tr>
<th></th>
<th>64,7 m</th>
<th>54,7/64,7 m</th>
<th>–</th>
<th>61,4/64,7/80 m</th>
<th>61,4/64,7/80/85/100 m</th>
<th>58,7/80/100 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hub heights - IEC</td>
<td>64,7 m</td>
<td>64,7 m</td>
<td>–</td>
<td>61,4 to 100 m</td>
<td>61,4/64,7/80/85/100 m</td>
<td>58,7/80/100 m</td>
</tr>
<tr>
<td>Hub heights - DIBT</td>
<td>64,7 m</td>
<td>64,7 m</td>
<td>–</td>
<td>61,4/64,7/80/85/100 m</td>
<td>58,7/80/100 m</td>
<td>58,7/80/100 m</td>
</tr>
</tbody>
</table>

Power control

<table>
<thead>
<tr>
<th></th>
<th>Active blade pitch control</th>
<th>Active blade pitch control</th>
<th>Active blade pitch control</th>
<th>Active blade pitch control</th>
<th>Active blade pitch control</th>
</tr>
</thead>
</table>

Gearbox

• Three step planetary spur gear system

Generator

• Doubly fed, three-phase induction (asynchronous)

Converter

• Pulse-width modulated IGBT frequency converter

Braking system (fail-safe)

• Electromechanical pitch control for each blade (3 self-contained systems)
• Hydraulic parking brake

Yaw system

• Electromechanical driven with wind direction sensor and automatic cable unwind

Control system

• PLC (Programmable logic controller) with remote control and monitoring system

Noise reduction

• Impact noise insulation of the gearbox and generator
• Noise reduced nacelle
• Rotor blades with minimized noise level

Lightning protection system

• Lightning receptors installed along blades
• Surge protection in electrical components

Tower design

• Multi-coated, conical tubular steel tower with safety ladder to the nacelle
• Load lifting system, load-bearing capacity over 200 kg

Operating limits (outside temperature)

• Cold weather extreme: -30°C to +40°C / -40°C to +50°C survival without operation
• Standard: -15°C to +40°C / -20°C to +50°C survival

Subject to technical alterations, errors and omissions. *only for WZII

www.gewindenergy.com
V90-1.8 MW
Maximum output at medium-wind sites in North America
WE DELIVER
ON THE PROMISE
OF WIND POWER
Built on experience
The V90-1.8 MW is designed to deliver optimal yield at medium-wind sites (IEC IIA) and builds on decades of experience with existing Vestas turbines. We started with the nacelle from the V80-2.0 MW workhorse. Then we added the revolutionary blades used on the V90-3.0 MW high-wind turbine. Finally, all components were tuned to operate in harmony and take advantage of the special characteristics of medium-wind sites.

Documented high availability and production
Vestas has installed more than 1,500 V90-2 MW class turbines, since the first one was launched in Europe in 2004. If you count the entire 2 MW class, that number climbs to 5,000. All these turbines offer documented high availability and production. The V90-1.8 MW delivers low cost of energy, thanks to documented reliability and the highest yield in its class.
Mature technology ensures stable revenue
The many V90-1.8 MW turbines already in operation provide Vestas with invaluable knowledge on which to base further development. This means the V90-1.8 MW is built on a mature, reliable design platform, with several turbines sharing innovative, high-performance technology. The turbine features a rugged 6-gear yaw system, a proven, conventional drive train concept, a 60 Hz 6-pole generator and a transformer, which is integrated with the nacelle to minimize power losses. Finally, the V90-1.8 MW is designed around a large number of standard components that several suppliers can provide, improving overall reliability and availability of the turbine.

Next-generation control system
The V90-1.8 MW is equipped with the latest turbine control and operation software, a state-of-the-art modular software platform developed to run the next generation of Vestas turbines. This software ensures reliable, automatic management of the V90-1.8 MW around the clock. Furthermore the software supports the service organization in monitoring and troubleshooting the wind turbines on site and remotely.

Innovative solutions for lubrication
The V90-1.8 MW offers a number of features that boost reliability and serviceability, including innovative solutions for lubricating key components such as the blade-bearing system and the yaw system.
Advanced grid operation and stable output
The V90-1.8 MW is equipped with VCUS™ (Vestas Converter Unity System), which ensures a constant and consistent output to the grid. Along with the turbine’s pitch control, VCUS™ also ensures energy optimization, low-noise operation and reduced load on the gearbox and other key components. Other VCUS™ advantages include effective fault ride through and complete variable speed capability.

Safety first and easy maintenance
Like all Vestas turbines, the V90-1.8 MW is designed for safe, convenient maintenance. Rotating parts are shielded, and all components are positioned to minimize service time and manpower.

3x44 meters of cutting edge
The revolutionary blades are made from carbon fiber and other lightweight materials. Even though V90s sweep a 27% greater area than V80s, the blade weight is almost the same. What’s more, the shape of the blades has been refined to deliver the greatest possible output while minimizing the load on the turbine. The shape also makes these blades less sensitive to dirt, providing better performance at sites affected by salt, insects or other particles in the air.
Can be installed almost anywhere
The V90-1.8 MW is designed for fast, easy transport by truck and rail to virtually any site in the world. The weight, height and width of all parts and main components are designed in consideration of local and international limits for standard transport. Installation, service and maintenance can be carried out using standard tools and equipment.

Special options
The V90-1.8 MW is available with a number of special options that can be provided at the customer's request. These options include:
- Condition monitoring system
- VestasOnline®, Compact or Business
- Switchgear
- Aviation markings on the blades
- Aviation lights
- Company logo
- Ice detection system
- Low temperature package allowing operation in temperatures as low as -30°C.
INNOVATIVE TECHNOLOGY FOR QUIET AND COOL OPERATION

CoolerTop™ saves energy and reduces sound levels
The environmentally friendly CoolerTop™ cools the water used in the turbine’s cooling system by channeling wind into the heat exchanger. This boosts reliability, not least by reducing the number of moving parts and electrical components in the cooling system. CoolerTop™ also reduces the turbine’s own energy consumption and it keeps sound levels low.

Low sound levels, high productivity
The V90-1.8 MW is a quiet turbine throughout its power curve, but it is even quieter during low-noise operation. The turbine can be operated in configurable modes that keep within defined noise levels, without having a significant effect on production. This makes the V90-1.8 MW ideally suited for sites where sound levels are a concern.
VESTAS TAKES CARE OF YOUR INVESTMENT ROUND THE CLOCK

Verified component lifetime
At the Vestas Testing Centre and Technology R&D, engineering experts and technicians use state-of-the-art testing methods to ensure that the turbine meets our standards for safety, performance and reliability throughout the 20-year service life. These tests push the components beyond their specifications. One method is known as Highly Accelerated Life Testing, which is performed in a HALT chamber. Extreme fluctuations in temperatures combined with heavy vibrations are just some of the stress tests the components are subjected to here. This enables Vestas to address design flaws before a turbine is introduced to the market.

Surveillance 24/7/365
Our surveillance services are manned 24/7 all year round to provide real-time surveillance, remote troubleshooting and other services. These services can also detect potential errors and disruptions before they occur, as data from your turbines is gathered and analyzed. This enables us to prepare a plan for preventative maintenance, in an effort to minimize unexpected production stops and costly downtime.

Service and maintenance
Vestas has service centers around the globe and we are able to cover your every need, from simple cleaning and planned maintenance to emergency call-outs and on-site inventories customized for your turbines.
Asset management and operation risk mitigation
Your wind turbines have to be maintained with great care to avoid exposing your investment to unnecessary risks. And that is exactly what Active Output Management is designed to ensure – that you get the greatest possible return on your investment in a Vestas wind turbine. AOM provides a number of advantages, such as detailed plans for service and maintenance, online monitoring, optimization and troubleshooting, and a competitive insurance scheme. We even offer a full availability guarantee, where Vestas pays compensation if the turbine fails to meet the agreed availability targets.

Project management for effective plants
The better your turbines fit your wind site, the more profitable your plant will be. That’s why Vestas offers to take on project management from the initial wind measurements to complete installation of the wind power plant. More than 30 years of international experience and local expertise enable us to complete:
- Wind and site studies
- Designing the wind power project
- Selecting wind turbine types
- Installing the wind farm
- Servicing and maintenance throughout the turbine’s service life
- Monitoring and remote troubleshooting.
TECHNICAL DATA FOR V90-1.8 MV

Power regulation: pitch regulated with variable speed

Operating data:
- Rated power: 1,800 kW
- Cut-in wind speed: 4 m/s
- Rated wind speed: 12 m/s
- Cut-out wind speed: 25 m/s
- Wind Class: IEC IIA
- Operating temperature: standard range
- Low temperature option: -20°C to 40°C
- Low temperature option: -30°C to 40°C

Sound power:
(10 m above ground, hub height 80 m, standard air density 1,225 kg/m³)
- 4 m/s: 95.6 dB(A)
- 5 m/s: 99.4 dB(A)
- 6 m/s: 102.3 dB(A)
- 7 m/s: 103.1 dB(A)
- >8 m/s: 103.5 dB(A)

Rotor:
- Rotor diameter: 90 m
- Swept area: 6,362 m²
- Nominal revolutions: 14.5 rpm
- Operational interval: 9.3 - 16.6 rpm
- Air brake: full blade feathering with 3 pitch cylinders

Tower
- Type: tubular steel tower
- Hub heights: 80 m and 95 m
- 80 m: Weight: 155 metric tonnes
- 95 m: Weight: 205 metric tonnes

Generator
- Type: 6-pole asynchronous with variable speed
- Nominal output: 1,800 kW
- Operational data: 60 Hz 690 V

Gearbox
- Type: 3-stage planetary/helical

Main dimensions:
- Blade:
  - Length: 44 m
  - Max. chord: 3.5 m
  - Weight: 6,700 kg
- Nacelle:
  - Height for transport: 4 m
  - Height installed (including CoolerTop): 5.4 m
  - Length: 10.4 m
  - Width: 3.4 m
  - Weight: 70 metric tonnes
- Hub:
  - Max. diameter: 3.3 m
  - Max. width: 4 m
  - Length: 4.2 m
  - Weight: 18 metric tonnes
- Tower:
  - 80 m: Weight: 155 metric tonnes
  - 95 m: Weight: 205 metric tonnes

Power curve V90-1.8 MW

All specifications are for informational purposes and are subject to change without notice. Vestas does not make any representations or extend any warranties, expressed or implied, as to the adequacy or accuracy of this information.

Noise reduced sound power modes are available.
S88-2.1 MW

S88-2.1 MW is designed for a medium wind speed regime. The wind turbine concept is based on robust design with pitch regulated blade operation, a three-stage gearbox with 2200 kW rating and flexible coupling to the asynchronous induction generator. The Suzlon flexi-slip system provides efficient control of the load and power control and the turbine operation is effectively controlled by the Suzlon controller. These technologies are all well known in the wind power industry and have proven themselves. The S88-2.1 MW is designed to withstand extreme conditions and operate effectively with low maintenance costs.

BLADES

As with all other Suzlon blades, the AEA3 blade is a fully integrated design. The blade manufacturing system, from mold engineering to state-of-the-art Resin Infusion Moulding (RIM), is implemented in close co-operation between the Dutch design team and the manufacturing plant operators. Blades for the world market are manufactured at Suzlon’s in-house facilities located in India, China, and the USA. Specifically in the North American market, the S88 blades are manufactured in our Pipestone, Minnesota facility.

PITCH SYSTEM

The full-span blade pitchning system is based on electrical motors with individual power backup which allows fast and efficient pitchning of the blades. With a resolution of 0.1° and a special fast-pitching mode, the S88-2.1 MW allows optimal power output as well as fast and safe braking of the rotor.

GEARBOX

Suzlon has always placed significant focus on gearbox design. The design philosophy is based on years of experience with wind turbines in harsh environments and our internal design standards exceeding the industry standards. The power rating of the Winergy gearbox for the S88-2.1 MW is actually 2.2 MW. With the acquisition of Hansen Transmission, Suzlon is further able to secure supply and design development of superior gearbox technology for the benefit of our customers.

SERVICE AND MAINTENANCE

Suzlon has teams of trained wind farm technicians around the globe who focus on excellence in service, maintenance and monitoring. Our service technicians aim to maximise energy production from the wind, and ensure the turbines operate reliably with minimal maintenance costs during their life span. The key emphasis is on maximizing availability and efficiency in operation thus providing ease of mind for our clients. Suzlon provides intensive and continuous training programs for its wind farm technicians, both in and out of field and complement our own training resources by using highly respected and reputable industry training consultants to tutor and train our technicians and technical support engineers.

MANUFACTURING

Suzlon’s manufacturing facilities for wind turbine genera-tor components and rotor blades are currently located in India, China, Belgium and the USA. As part of Suzlon’s strategic growth plans to significantly increase manufacturability capacity of all key turbine components, a number of new facilities are currently planned or under construction. This will meet the objective to vertically integrate the entire supply chain, ensuring that Suzlon brings to the market cost efficient and reliable technology. It will also help control the supply chain to secure quality, volume and growth, as well as deliver long term service support to customers.

END TO END SOLUTIONS SINCE 1995

The End-to-End solution pattern is built on Suzlon’s expertise in technology, processes and thorough understanding of the wind energy market. It is a unique combination of proven technology, and a bundle of value added services. Under this successful and proven business model, Suzlon undertakes the complete turn-key responsibility - from arranging land; to equipment supply & EPC; to nodal agency clearances; to life-cycle operations & maintenance of projects. Customers therefore do not have to engage extra manpower for their wind projects. Suzlon brought about a paradigm shift in the wind energy market with the End-to-End solutions. It made setting up wind energy projects simple, hassle-free and enabled hundreds of customers including small/medium/big enterprises, Indian and multinational corporates, public sector companies and even individuals set-up their own wind energy projects with confidence and ease.

World’s 5th largest and fastest growing integrated wind turbine manufacturer | 400 kW to 2.1 MW capacity wind turbines | Workforce of 14,000 people and a global presence in 21 countries across 3 continents | Manufacturing units in 3 continents | R&D facilities in Germany and The Netherlands
S88-2.1 MW

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BLADES

As with all other Sulzan blades, the A43 blade is a fully integrated design. The blade manufacturing system, from mould engineering to state-of-the-art Resin Infusion Moulding (RIM), is implemented in close co-operation between the Dutch design team and the manufacturing plant operators. Blades for the world market are manufactured at Sulzan’s in-house facilities located in India, China and the USA. Specifically in the North American market, the S88 blades are manufactured in our Pipestone, Minnesota facility.

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POWER CURVE

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