

GEV HP 1MW

Wind with a vision



Birdlike™

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V-Scada™

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GEV HP
1MW

62-m rotor
70-m height

Designed to go far

Vergnet's GEV HP is the culmination of 20 years of perfecting and fine-tuning wind turbines throughout the entire world.

As a significant advancement of Vergnet's long-proven Farwind® technology, GEV HP addresses the specific needs of complex sites.

It offers new opportunities to oil-dependent countries, since utilities can now consider installing powerful 1MW wind turbines in almost any location.

Key cost-saving features, such as convenient transport and installation, as well as ground-level maintenance, set a new standard in wind energy business models. Robust design, extended climate protection and weak grid compliance allow it to withstand the harshest conditions over its entire lifetime, thus offering high availability.

By choosing GEV HP, which features both performance and reliability, you ensure your wind farm project will offer maximum return on your investment.



Easy to transport



Easy to install



Ground-level maintenance



Hurricane-proof



Robust and long-lasting



Suited for the harshest conditions



High performance



Grid-friendly

A LIGHT, COMPACT AND VERSATILE DESIGN

Lightweight structure

The entire GEV HP has been designed to provide the highest power output through the most compact and reliable means. Despite being 70m tall, it only weighs 130T. This means a power density of 7.7kW/ton, and a 33% weight reduction compared to the average weight in its megawatt class.

Compact nacelle

The nacelle is specifically designed to fit in 40' standard containers.

Light tower

Because it is guyed, the tower is extremely light compared to a conventional one. It comes in 12-meter parts, and fits in 40' standard containers.

Self-erecting device

The tower is raised thanks to an integrated erection tool. No need to bring a large, costly crane. Only a 50- to 90-ton one is required. Then the nacelle and the blades are lifted to the top of the tower using the permanent upper beam.

Guy wires

6 guy wires allow the whole structure to be extremely lightweight and compact. A high-quality fastening system, similar to the one found in suspension bridges, guarantees complete safety, even during hurricanes and earthquakes.

Coated guy wires

Steel guy wires are covered with polyethylene to ensure maximum protection, especially in salty environments.

Guy wires anchorages

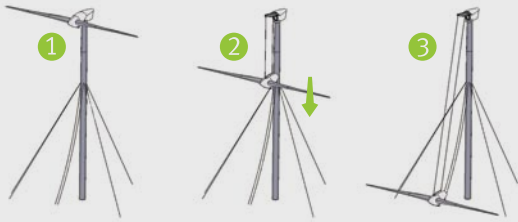
Only a small quantity of concrete is necessary to anchor the guy wires, which fit in 20-cm drilled holes.

Reduced foundation

The light, guyed tower allows for a much smaller foundation; therefore, the amount of concrete required is two thirds less than conventional 1MW wind turbines.

BIRDLIKE™ Lowering system

Thanks to this unique and patented system, servicing and blade cleaning can be performed at ground level. Cranes and specialized teams are not required. The upwind part of the nacelle lowers smoothly to the service position in a rapid, easy and secure operation.



Hurricane-proof

The lowering system also grants hurricane protection.

Earthquake-proof

The guyed tower's adaptable architecture is also efficient in seismic areas.

Maintenance crane

The maintenance crane located in the nacelle allows easy handling of components, tools and supplies.

Landing platform

A dedicated platform allows convenient and secure servicing over the entire lifetime of the wind turbine.



EASY TO TRANSPORT

At Vergnet, we know what *remote* means. For more than 20 years we have been developing solutions for the most isolated sites. With GEV HP, you can now install 1MW wind turbines almost anywhere around the world. Packed in standard containers, GEV HP can be shipped rapidly and cost-effectively. Standard trucks, unpaved roads, islands, hilly and mountainous countries... We can reach any destination.



EASY TO INSTALL

Installation costs are critical to wind farm business models. This is particularly true in countries where heavy equipment is scarce or non-existent. GEV HP is purposefully designed to be installed almost anywhere in the world even with limited equipment. Its light structure and self-erecting device are the keys for easy and cost-effective installation.



GROUND-LEVEL MAINTENANCE

To achieve profitability, a wind turbine requires high availability. This concern led us to develop GEV HP's unique lowering system. This ingenious device allows utilities to drastically reduce operating costs and maintenance downtime, thus achieving high availability rates and lower operating costs.



HURRICANE-PROOF

Thanks to its unique lowering system, GEV HP can be installed in high wind-prone areas and can even sustain up to Category 5 hurricane winds. In case of an alert, the upwind nacelle, including the rotor blades, is lowered to the landing platform and secured to the ground. This hurricane protection is recognized by our insurers.

C5M coating

The tower and all exposed parts are protected by a C5M-certified coating, according to DIN EN ISO 12944 standards, which ensures effective protection during the entire usage time even in wet, salty, corrosive or abrasive conditions.

All-terrain generator

The generator is designed to operate even in extreme weather conditions:

- from -20°C to +50°C
- insulation class H (maximum temperature at hottest spot: 180°C)
- 100% relative humidity
- marine environment
- dust, salt, sand, ice or snow intrusion in the nacelle (IP 55 sealing protection)
- specific tropical corrosion treatment of the stator and rotor, including stainless steel greasers, screws and fan cover

Cooled grid management system

Critical parts are immune from heating problems thanks to a specifically designed cooling unit.

Gear system

The drive train is both robust and compact, with a 3-stage gearbox (1 high torque planetary stage and 2 parallel stages)

Protected sensors

Sensors and actuators are designed for the most extreme weather conditions, thanks to specific features such as:

- additional varnish coat on electronic components to withstand possible condensation
- High protection grade sealed connectors (up to IP 67)
- EMC immunity



SUITED FOR THE HARSHTEST CONDITIONS

Our 20 years of worldwide experience helped us develop the best technical answers to ensure maximum reliability in the harshest conditions. All components are sheltered. Nothing has been neglected. Wherever the site may be, GEV HP will provide trustworthy power production during its entire service life.



Wear-proof blades

The rotor blades are protected from wind, water, salt, and UV radiation by specialized coatings. In sandstorm areas, blades can be damaged by incessant abrasion. To prevent damage, anti-abrasion strips can be adhered to the leading edge. Thanks to the lowering and lifting system, these strips can be changed as often as necessary throughout the turbine's entire lifetime.

Cooled gearbox

The gearbox is cooled by an air/oil cooling system, which allows operation between -10°C and +50°C.

Heavy-duty design

All parts of GEV HP are made from superior quality materials. Major cast components, including rotor hubs, are made of spheroidal graphite cast iron. All parts are subject to the strictest quality assurance testing, in order to meet the highest resistance requirements. The whole GEV HP is designed to bear 365 grid outages per year, compared with 20 per year for conventional turbines.

First-class components

The entire machine was developed in close collaboration with world-class partners. Most parts are standard and widely used in many industries, which proves their reliability. Specially designed components are drawn on a 3-D CAD system and tested using FEM calculations in order to optimize performance. Manufacturing is outsourced to specialized and well-established industrial suppliers. Germanischer Lloyd certification for a 20-year fatigue life is in progress.

Resistant nacelle cover

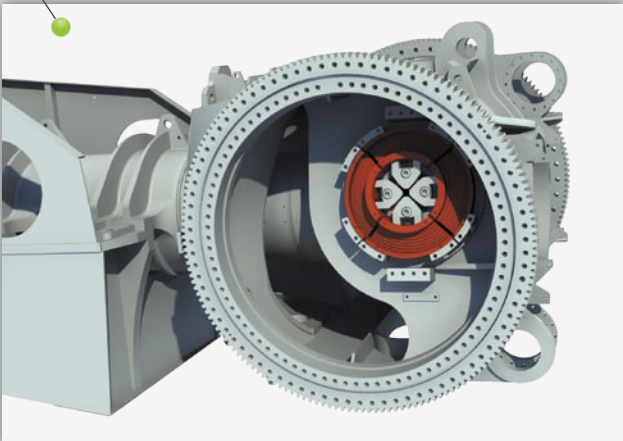
Avoids intake of dust, sand, moisture or salt into the nacelle, thus ensuring total protection of the inner components.

Blades

Rotor blades feature a high strength-versus-weight ratio and high elasticity, thanks to their innovative design, and state-of-the-art manufacturing. Blade design and manufacturing are detailed on page 10.

BIRDLIKE™
Delta-3 teetering hub

This innovative technology drastically reduces load fluctuations caused by wind turbulence, especially sudden squalls. Based upon geometric and material properties, it is simple and effective. It reduces stress on the whole structure, including drive train and tower, by 35%, thereby reducing maintenance costs and providing a longer turbine life.



ROBUSTNESS AND RELIABILITY

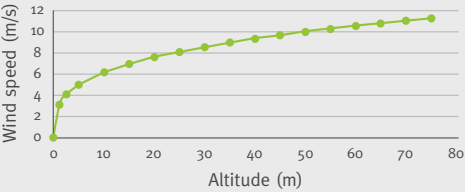
Throughout its entire service life, a wind turbine must withstand unequalled loads and stresses, especially in extreme weather conditions. That is why priority was given to robustness when designing GEV HP. Nothing was left to chance: high quality materials and state-of-the-art manufacturing, together with the most advanced dampening technologies, guarantees outstanding reliability.

Higher energy production even in hurricane-prone areas

Thanks to the lowering system, a class-3 GEV HP can be installed in places where in the past only reinforced class-1 conventional wind turbines could be installed. This means an increased rotor swept area, and thus, higher energy production. Finally, a better investment!

70-m high nacelle

The hurricane-proof design allows GEV HP to feature a high tower, thus better energy yield. Winds increase with higher altitudes, as shown in the chart below.



Electrical pitch regulation

The pitch regulation allows smooth power control with digital accuracy, thus real-time optimizing the energy yield.

Active yaw system

Safety systems

The safety system guarantees secure operation of the turbine in accordance with the stipulations of international standards and independent institutes. The following main parts are included:

- Aerodynamic braking system through pitch regulation, including individual backup power units in case of supply failure
- safety rotor lock system to ensure safe service operations
- lightning protection

BIRDLIKE™
62-m two-blade rotor

GEV HP offers high efficiency thanks to its 3020m² rotor swept area.

Sensor system

An extensive sensor system ensures safe and efficient operation of the turbine.

ECLECTIC™
Full Scale Drive through IGBT

The Full Scale Drive performs electronic filtering of torque and power variations. This advanced technology offers many benefits:

- Yield-optimized control
- High-quality current, as IGBT inverter and harmonics filters feed the grid with a pure sine-wave signal
- Fault ride-through capability: even in severe voltage drops, the Full Scale Drive allows the wind turbine to remain connected to the grid
- Reduction of mechanical stress on the wind turbine components by neutralizing peak loads

Grid support

The Full Scale Drive allows the generator to perform variable speed, which allows fine-tuning of reactive power compensation. This feature helps maintain voltage grid stability by supplying or accepting reactive power in case of grid failure.

V-SCADA™

- performs real-time monitoring of power production and helps maximize yield
- can be used from the on-site supervision station, or remotely
- allows recovery from system failures directly from a remote computer or from Vergnet headquarters: no need to send a technician.
- records data and establishes statistics in graphical, user-friendly forms
- is designed to transfer data through any telecommunications system locally available, either analog (public phone wire) or digital
- is secured in case of grid outage by a 300 Ah battery located in the electrical building

Electrical building

Grid management components are located in the electrical building positioned near the wind turbine's tower base. It is easy to access and immune from heating problems.

Industrial PLC

The PLC (Programmable Logical Controller) constantly monitors all the necessary parameters:

- Wind data
- Wind turbine parameters (rotor speed, blade angle, yaw position, generator power output...)
- Grid parameters (voltage, current and frequency)

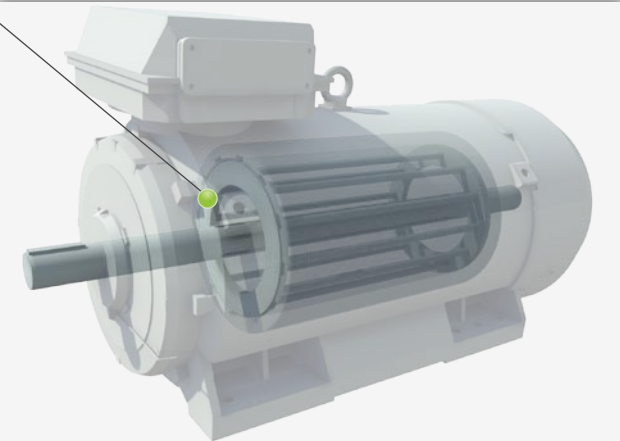
It keeps the wind turbine within the operating limits, helps achieve maximum output under any weather conditions, avoids malfunctions and reduces mechanical stress.

Variable-speed generator

Power production is performed through a robust and reliable squirrel-cage generator, supplied by a first-class specialist. Connected to the Full Scale Drive, the variable-speed generator allows optimal rotor rotation in any wind conditions, or to meet any particular reduced power level requirement.



The whole GEV HP is designed to make the most of wind potential. The 62-m rotor at 70-m high harnesses maximum wind energy, while state-of-the-art mechanics and electronics demonstrate high performance and ensure excellent energy yield. That is how GEV HP secures your return on investment.



In many countries, grids suffer from frequent disturbances, which add specific concerns to the standard utilities' requirements. When developing GEV HP, we took special care with the power electronics. GEV HP complies with the main international grid codes (EON, REE and AEMEC), and can easily be integrated into any grid. It achieves reliable operation in weak or small grids, through harmonics-free power supply, effective fault ride-through capability and grid support in case of failure.

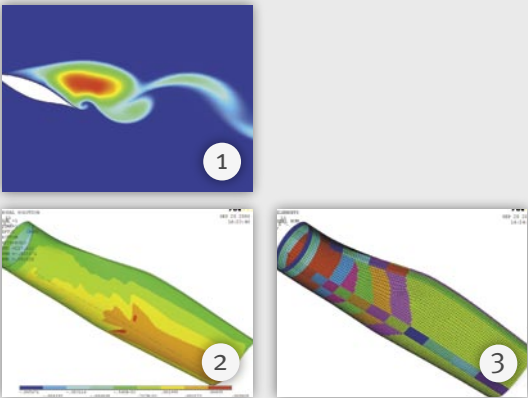
Blades are critical to wind turbine efficiency. That is why we chose to fully integrate blade production, from design to manufacturing.

2-blade rotor: a fresh look to rotor design

- Our 2-blade rotor offers a real breakthrough in wind turbine design. It offers the following benefits:
- Combination of high efficiency with lightness, the rotor swept area being the same as a 3-blade turbine
 - Wider and thicker blades, which mean higher resistance, and consequently increased lifetime
 - Low-cost maintenance through ground-level servicing and blade cleaning
 - Hurricane protection via the lowering system

Advanced blade design

The optimized profile of the rotor blades enhances the ratio power yield / blades weight.

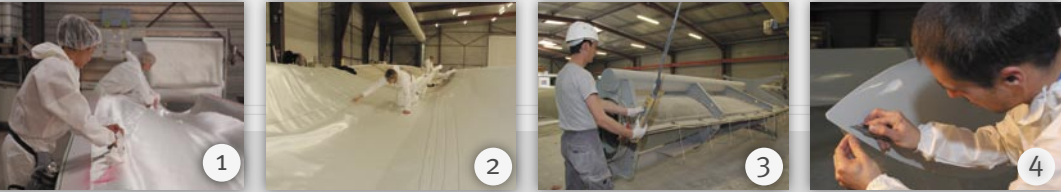


1 - Airflow numerical model for blade design optimization
2 and 3 - 3-D numeric models for resistance testing

State-of-the-art processes

We manufacture blades through the most advanced process: vacuum infusion. Composite fiber mats are placed in the mold and vacuum-impregnated with composite thanks to a pump and a hose system. Compared to hand lay-up, this process provides many advantages: increased resistance through improved physical properties (no air pockets in the laminate),

and lightness thanks to a more precise weight control offered by the exact setting of the material. In order to ensure maximum reliability over the entire lifetime of the machine, a finish process including gel coat, filler and edge protection, protects the rotor blades.



Fully-integrated blade manufacturing ensures the highest quality level

State-of-the-art manufacturing is fully integrated and performed by experienced technicians in our 5000 m² facilities located in France. Detailed procedural and work instructions, combined with strict inspections, ensure the highest quality level.

1 - Glass fabrics cutting
2 - Structural glass fabrics laying
3 - Laminate parts bonding
4 - Leading edge protection laying

TURBINE CONCEPT

- 2-blade upwind rotor
- Delta-3 teetering hub with elastic damper
- Variable pitch control
- Full Scale Drive - IGBT converter

GERMANISCHER LLOYD IEC 61400-1 Certification (pending)

- Cut in wind speed - m/s 3
- Cut out wind speed - m/s 25
- Output Voltage & Frequency 690V - 50 or 60Hz
- Noise regulation adjustable from 99,7 to 104,4dBA

• Class (as per IEC 61400-1)	III	II	I
• Hub height - m	70	70	60
• Rotor diameter - m	62	58	55
• Rotation speed - rpm	12 to 23	13 to 24	14 to 26
• Max. wind speed - m/s			
operating position	52.5	59.5	70
lowered position	86	86	86

EXTREME CONDITION PROTECTION

- Corrosion Tower: marine painting C5
- Generator tightness / insulation IP55 / Reinforced H class
- Hurricane resistance BIRDLIKE™ lowering system
- Earthquake resistance Flexible architecture (guyed tower)
Multi-pole, shock-absorbent anchors
- Lightning protection Fully-integrated lightning protection - (IEC - 61400 - 24)
- Electrical protection HTA Interrupting cell by fuse inside the electrical building
- Security Safety ladder
- Operating limits From -10°C to +50°C

PERFORMANCE DETAILS

- Gearbox 3-stage epicyclic & parallel gearing
- Generator Asynchronous squirrel cage
Rotor: Variable speed through PLC
- Emergency and parking brake Disc on shaft
- Yaw Hydromechanical yaw
Hydraulic yaw brake

TOWER

- Type Guyed wire, Tubular or Lattice
- Sections 6 x 12m
- Material Galvanized steel
- Installation Self-erecting device
- Anchors Boreholes with steel rods cast in concrete
Volume according to soil study (avg.: 96m³)

CONTROL COMMAND SYSTEM

- Automation control Siemens PLC through Profibus / Ethernet protocol
- UPS (voltage outage) 300Ah
- Remote supervision V-SCADA™ / through RTC, radio, Internet...

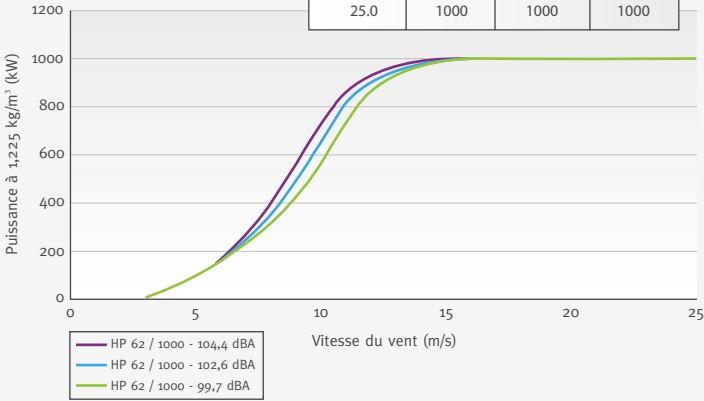
WEIGHT - DIMENSIONS (CLASS III)

- Blades / unit 4.5t - 30m
- Gearbox 6.5t
- Generator 4.7t
- Nacelle (both parts) 65t - 14,8m x 4,6m x 4,9m
- Tubular / Lattice tower 78t / 65t - 70m

MANUFACTURERS

- Blades ACO (VERGNET)
- Blade design AEROTROPE
- Gearbox WINERGY (SIEMENS)
- Generator ABB
- Controller SIEMENS
- Converter ABB
- Yaw brake SIME STROMAG

POWER CURVE



Wind speed (m/s) d=1.225kg.m ³	Power (kW)		
	104.4dBA	102.6dBA	99.7dBA
3.0	7	7	7
4.0	43	43	43
5.0	95	95	95
6.0	168	165	160
7.0	269	250	234
8.0	399	354	317
9.0	560	487	423
10.0	731	652	564
11.0	859	817	738
12.0	929	908	863
13.0	969	957	936
14.0	990	984	972
15.0	1000	999	992
16.0	1000	1000	1000
17.0	1000	1000	1000
18.0	1000	1000	1000
19.0	1000	1000	1000
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