




SIEMENS



Siemens D3 platform – 3.0-MW direct drive wind turbines



Reduced complexity,
increased profitability



Answers for energy.



Your trusted partner

Siemens has been a major driver of innovation in the wind power industry since 1980 when wind turbine technology was still in its infancy.

Technology has changed with the times, but Siemens' commitment to providing its customers with proven wind turbine solutions remains the same.

The combination of robust and reliable turbines, highly efficient solutions for power transmission and distribution, and a deep understanding of the entire energy market ensures that Siemens will continue to take the wind power industry to new levels.

When it comes to on-time delivery, Siemens' record is outstanding. Long-lasting customer relationships, based on a track record of successful, reliable project deliveries, provide a sound, sustainable and profitable investment.

Drawing on more than 30 years of experience in the wind power industry, a strong focus on renewables and a global network of highly-skilled and trained employees, Siemens has proven itself to be a trustworthy and reliable business partner, and will continue to be so in the future.

With an increasing number of turbines being installed at inland, coastal and offshore sites, reliability and best in class maintenance under challenging conditions are essential for optimizing return on investment throughout a project's life cycle.

Over the past 30 years, Siemens has accumulated millions of hours of service experience. Drawing on this substantial knowledge, the company has established a flexible range of service solutions that are designed to optimize the output of wind turbines.



SWT-3.0-101



SWT-3.0-108



SWT-3.0-113

Intelligent ways to drive down the cost of electricity

Wind power is coming of age. It could soon be directly competitive with traditional energy sources.

Driving down the levelized cost of wind energy is a key target for Siemens as we strive to make wind power independent of subsidies.

Innovation and industrialization are the core levers to this. And our new platform strategy, founded on the knowledge and experience of more than 30 years in wind power, is a milestone on this path.

Standardization and modularization are fundamental to the new platform approach – allowing us to streamline the entire manufacturing and installation process. The categorization into product platforms allows standardized modules, such as rotors, generators, towers or hubs, to be used across different products. Thereby the total number of different components is kept to a minimum.

All of which means that we are helping our customers drive down the cost of electricity.

Each of our products is now a member of one of four platforms: the Siemens G2, Siemens D3, Siemens G4 and Siemens D6. “G” denotes geared turbines, “D” signifies direct drive technology and the associated numbers represent the predominant power rating. Therefore, the D3 platform is comprised of onshore direct drive wind turbines with a power rating of 3.0-MW.

Outstanding performance with reduced complexity

The Siemens 3.0-MW wind turbines of the D3 platform embody tried and tested innovation in the field of direct drive generators, with hundreds of units already installed and operational.

As wind power plants develop capacities similar to conventional power plants, power generation companies throughout the world are striving for greater efficiency and cost-effectiveness. Siemens’ solution: increase availability and profitability through innovative technology and reduced complexity.

Siemens direct drive turbines of the D3 and D6 platforms offer innovation through the consistent implementation of a common, highly efficient generator concept. With less than half the moving parts of a conventional geared turbine, the direct drive wind turbines improve performance, reliability and maintainability. In addition, the compacted design allows for cost-effective transportation and installation.



Performance and profitability go hand in hand

With its direct drive wind turbines, Siemens started with the ambitious aim of making a more cost-effective machine in order to become competitive with conventional power plants. Thanks to innovative engineering, that vision is becoming a reality.

In designing a wind turbine, a holistic view of the design and construction, materials, processes, manufacture, and installation is critical. The gearless 3.0-MW wind turbines carefully balance all these factors in a compact system. Service personnel have been involved in the development process in order to optimize working conditions and serviceability.

Reduced complexity

The Siemens D3 platform offers the simplest and most straightforward wind turbine design. Regardless of the reliable track record of gearboxes over the years, the

gearbox is fundamentally the most complex component of a wind turbine. Eliminating the gearbox reduces complexity and can increase reliability.

Replacing the gearbox, the coupling and the high-speed generator with a low-speed generator eliminates two-thirds of the conventional drive train arrangement. As a result, the number of rotating and wear-prone parts is vastly reduced compared to a geared machine. Siemens has opted for a permanent magnet generator for improved efficiency.

Unlike an electrically-excited machine with a gearbox, a permanent magnet-excited machine does not expend any energy on the excitation itself. The D3 platform wind turbine generators also have an outer rotor, where the rotor spins on the outside of the stator. This design feature allows the rotor to operate within narrower tolerances, which helps to keep the dimensions of the nacelle compact.

Simplified design

Due to the removal of the gearbox and other design simplifications, Siemens has given service technicians more space within the nacelle. Here, key components are readily accessible and can be interchanged without impacting others. The wind turbines of the D3 platform have a dual cooling system that provides an even cooling of the generator via a top-mounted, passive cooling system for improved energy efficiency.

The key components in a wind turbine – the blade, rotor hub, tower, and controller – are all adopted from the existing Siemens geared turbine portfolio. The utilization of proven components alongside rigorous testing on rigs and in the field enables Siemens to eliminate many of the variables traditionally associated with the introduction of such an innovative product.

Innovative tower solution

Higher towers significantly increase the energy yield of a wind turbine on sites with a high wind shear. At the same time, they pose considerable challenges in terms of transportability and costs. Siemens offers an innovative and economically-viable tower concept to allow its wind turbines to reach heights above 100 meters.

The bolted steel shell tower consists of multiple tower sections, mounted on top of each other and assembled together on site. The modular space concept of the bolted steel shell tower allows for very high hub heights (in excess of 140 meters) with very low transportation requirements. The tower is erected in a short time and requires minimal maintenance. In fact, the HRC bolts require no re-torquing during the tower's lifetime.

Ease of transportation and erection

The D3 platform has a compact, light-weight design and has been engineered to meet even the most demanding of transportation routes. Key bridge and tunnel clearance specifications have been carefully considered when engineering the machine, and as a result, the 3.0-MW wind turbine can navigate many of the most demanding transport routes.



Expertise in practice: fully developed technology, advanced design

Grid performance with NetConverter®

Siemens sets the standard in the field of grid compliance. Power conversion is implemented by the Siemens' NetConverter® system. This system is characterized by full conversion of the power generated, efficiently decoupling generator and turbine dynamics from the grid. The NetConverter® system offers maximum flexibility in the turbine's response to voltage and frequency control, fault ride-through and output adjustment. As a result, Siemens wind turbines can be configured to comply with a variety of relevant grid codes in major markets and can be readily connected to the grid.

Siemens IntegralBlade®

The rotors of the D3 platform benefit from blades manufactured using patented IntegralBlade® technology. The blades are made in one piece from fiberglass-reinforced epoxy resin during a single production step. As a result, all glue joints – the potential weak points that could expose the structure to cracking, water ingress, ice formation and lightning – are eliminated.

Siemens WebWPS SCADA system

Via a standard web browser, the Siemens WebWPS SCADA system provides a variety of status views of electrical and mechanical data, operation and fault status, meteorological and grid station data.

Wind turbine condition monitoring

Siemens' wind turbine condition monitoring compares the vibration levels of the main nacelle components with a set of established reference spectra and instantly detects deviations from normal operating conditions. This allows Siemens to proactively plan the service and maintenance of the wind turbines, as any unusual event can be categorized and prioritized based on severity.

Turbine Load Control (TLC)

The Turbine Load Control system continuously monitors the structural loading on the wind turbine. In case the loads exceed normal values, the turbine automatically regulates operation to bring loads back within the design envelope. In addition, the TLC system – an optional feature of the D3 platform – monitors the accumulated fatigue loading on the turbine, thereby providing key input for fact-based asset management.

High Wind Ride Through (HWRT)

Wind turbines are normally programmed to shut down if the 10-minute mean wind speed exceeds 25 m/s. This may lead to significant challenges for the grid system if the turbines in large wind farms are shut down more or less simultaneously, e.g. at the passage of a gust front. The Siemens D3 platform works to enhance grid stability due to High Wind Ride Through – an optional feature of the D3 platform. This replaces the fixed high wind shutdown-threshold with an intelligent load-based reduction in output power at some storm level wind speeds.

Service

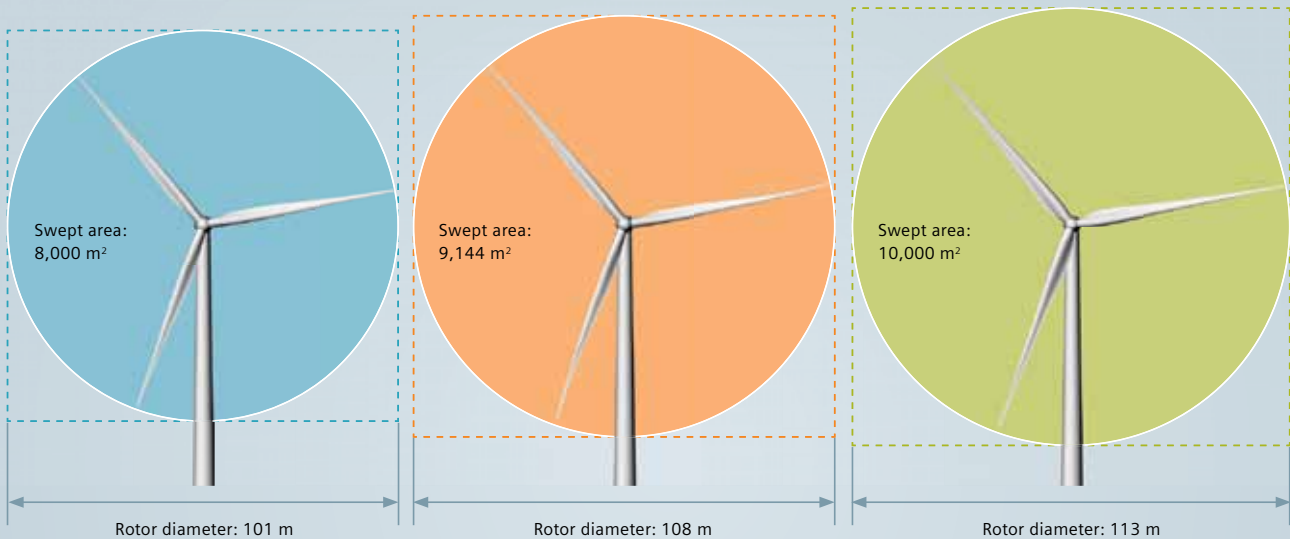
From the highly qualified local technician, to the senior engineer at service headquarters, it is the track record and the vast obtained experience of the Siemens service team that makes the difference.

Siemens offers tailor-made service solutions for each of our turbine platforms, e.g. the SWPS-100B, the SWPS-200A and the SWPS-300W service solutions for onshore wind turbines.

Further improvements in safety

Safety is at the heart of all Siemens operations. From production to installation, operation, and service, Siemens strives to set the standard for a zero harm culture.

In addition the fail-to-safe capabilities within a turbine, combined with Siemens' superior lightning protection system, are designed to enhance overall safety.



SWT-3.0-101

IEC Class	IA
Rotor diameter	101 m
Blade length	49 m
Swept area	8,000 m ²
Hub height	74.5 – 99.5 m*
Power regulation	Pitch regulated
Annual output at 7.5 m/s	10,500 MWh
Nacelle weight	78 t
Rotor weight	60 t

SWT-3.0-108

IEC Class	IA
Rotor diameter	108 m
Blade length	53 m
Swept area	9,144 m ²
Hub height	79.5 m*
Power regulation	Pitch regulated
Annual output at 7.5 m/s	11,100 MWh
Nacelle weight	78 t
Rotor weight	60 t

SWT-3.0-113

IEC Class	IIA
Rotor diameter	113 m
Blade length	55 m
Swept area	10,000 m ²
Hub height	79.5 – 142 m*
Power regulation	Pitch regulated
Annual output at 7.5 m/s	11,800 MWh
Nacelle weight	78 t
Rotor weight	67 t

* site specific

SWT-3.0-101

The toughest turbine for the roughest conditions

Extreme wind conditions place tremendous loads on a turbine. The SWT-3.0-101 is built to deliver reliable performance under the world's harshest operating conditions.

The SWT-3.0-101 utilizes the same rotor as Siemens' SWT-2.3-101 geared machine. Through the application of proven components, Siemens balances innovation with security of investment.

SWT-3.0-108

The durable choice for strong wind conditions

When winds are strong, the SWT-3.0-108 offers a superior combination of a large rotor and robust design.

The B53 quantum blade of the 108-meter rotor uses Siemens' innovative aeroelastic blade design, which allows a larger rotor diameter and higher energy output without compromising structural loads. As a result, the SWT-3.0-108 turbine provides a lower cost of energy in high wind conditions.

SWT-3.0-113

Getting the most out of moderate conditions

Offering the largest rotor in the Siemens D3 platform, the SWT-3.0-113 is designed to increase energy output at sites with moderate wind conditions.

Once again the competitive edge of a Siemens turbine is based on innovative blade design. The B55 quantum blade benefits from an optimized root design extracting maximum power from the wind. Furthermore, the SWT-3.0-113 has reduced noise emissions due to a lower rotor speed. With its combination of high energy output and low noise levels, the SWT-3.0-113 is the ideal choice for most inland sites across the globe.

The Siemens D3 platform – one of the four new product platforms – embodies tried and tested innovation in the field of direct drive generators. Offering three rotor sizes and a standard rating of 3.0-MW, the D3 platform is a perfect combination of performance and profitability for all wind conditions.

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