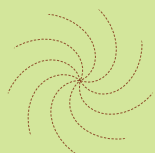




**Northern's NorthWind 100/19 wind turbine provides cost-effective, highly reliable renewable energy in demanding environments.**



[www.northernpower.com](http://www.northernpower.com)

## The North Wind<sup>®</sup> NW100/19 Simplicity by Design

Designed specifically for extreme weather in isolated grid and distributed generation applications, the NW100/19 is a state of the art, village-scale wind turbine. Northern Power Systems has drawn on 30 years of experience to engineer a wind turbine that provides cost-effective, highly reliable renewable energy in demanding environments.

Meeting the needs of small utilities and independent power producers, the NW100/19 has the following features:

### Simplicity

High reliability and low maintenance were the focus in developing the NW100/19. The design integrates industry proven robust components with innovative design features to maximize wind energy capture in severe and remote locations. The turbine features a minimum of moving parts and vulnerable subsystems to deliver high system availability. The uncomplicated rotor design allows safe, efficient turbine operation.

- Direct drive generator eliminates the drivetrain gearbox
- Dual fail-safe disk brake and electro-dynamic braking system eliminates blade brakes



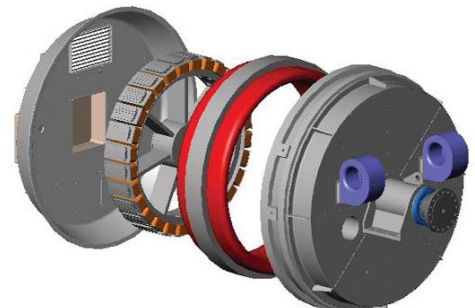
### Serviceability

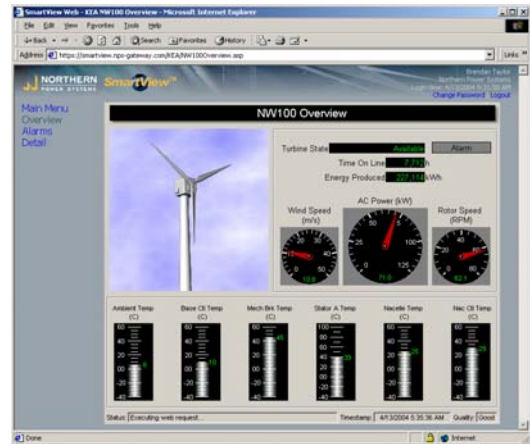
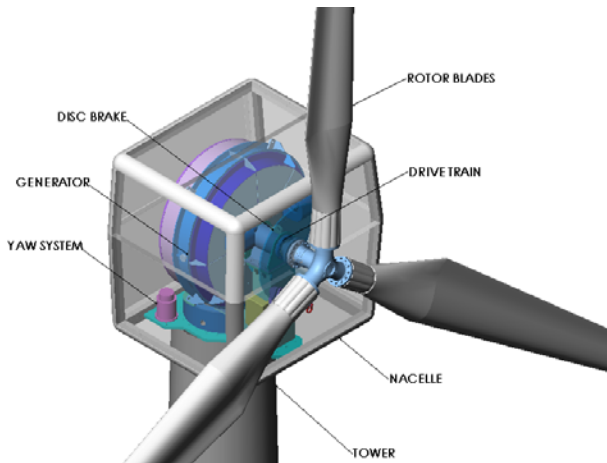
All service activities can occur within the tubular tower or nacelle housing, providing complete protection from severe weather conditions. Designated work areas provide ample room to perform service activities.

### Power Quality

The most common generator utilized in the wind industry is a gear driven asynchronous (induction) generator. Induction generators must be connected to a stable voltage source for excitation and reactive power (VAR) support. While large power grids can easily provide this support, power quality and system stability is compromised in distributed generation and village systems where the power grid is typically "soft and unbalanced."

Northern has solved this issue with the NW100/19. Our synchronous, variable speed direct drive generator





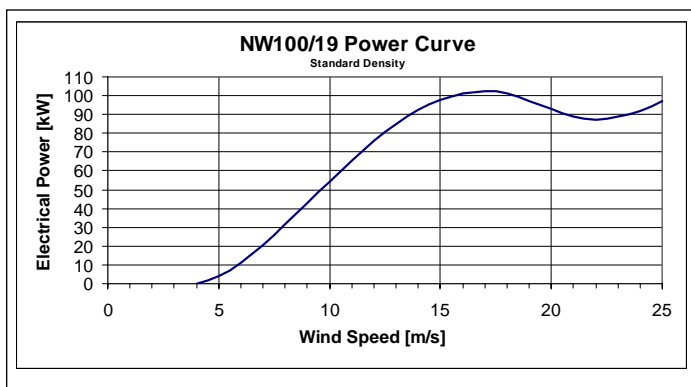
Integrated web-based SmartView™ monitoring system

and integrated power converter increases energy capture, while eliminating current in-rush during control transitions. This turbine can be connected to large power grids and remote wind-diesel configurations without inducing surges, effectively providing grid support rather than compromising it.

### System Description

The variable speed, stall controlled turbine rotor assembly consists of three fiberglass reinforced plastic (FRP) blades bolted to a rigid hub, which mounts directly to the generator shaft. This simple, robust design eliminates the need for rotating blade tips, blade pitch systems, and speed increasing gearboxes.

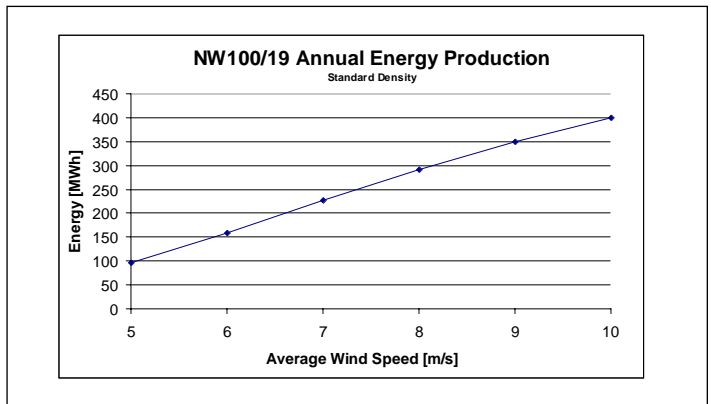
Using a state-of-the-art airfoil design increases the blade's aerodynamic efficiency and renders them insensitive to surface roughness caused by dirt build-up and insects. The advanced FRP-resin infusion molding process ensures a high-quality blade while the cold chamber tested root connection guarantees it will meet extreme temperature requirements.



The direct drive generator is a salient pole synchronous machine designed specifically for high reliability applications. Electrical output of the generator is converted to high quality AC power that can be synchronized to conventional or weak isolated grids. The advanced power conversion system also eliminates the inrush currents and poor power factor of conventional wind turbines.

The variable speed direct drive generator/converter system is tuned to operate the rotor at the peak performance coefficient, and also allows stall point rotor control to contend with wide variation in air density found in the target applications.

The safety system consists of a spring applied, pressure released disk brake mounted on the generator shaft for emergency conditions, and an electrodynamic brake system that provides both normal shutdown and emergency braking backup functions.



## NW100/19 Technical Specifications

### Design Specifications

Turbine Class	IEC WTGS Class S, High Density
Design Life	30 year
Design Standards	In accordance with IEC 61400-1

### Performance

Nominal Power Rating	100 kW
Rated Wind Speed	15 m/s (34mph)
Cut-In Wind Speed	4 m/s ( 9mph)
Cut-Out Wind Speed	25 m/s (56mph)
Survival Wind Speed	60 m/s (132mph)

### General Configuration

Rotation Axis	Horizontal
Orientation	Upwind
Yaw Control	Active
Number of Blades	3
Hub Type	Rigid
Drive Train	Direct Drive
Power Regulation	Variable Speed Stall

### Rotor

Diameter	19.1 m
Swept Area	284 m <sup>2</sup>
Speed Range	45-69 RPM
Speed @ rated power	57 RPM
Structural Configuration	Flange Mounted Blades, Rigid Hub
Power Regulation	Variable Speed Stall
Rotor Rotation	Clockwise (Viewed from Upwind)
Coning	0°

### Blades

Airfoil	S819, S820, S821 Series
Material	Fiberglass Reinforced Plastic (FRP)
Lightning Protection	Standard Integrated System

### Drive Train

Configuration	Variable Speed Direct Drive
Tilt Angle	4°
Generator Type	Salient Pole Synchronous
Insulation Class	NEMA H
Generating Speed	45-69 RPM
Generator Rating	100 kW w/ 1.15 Service Factor
Speed Control	Caliper Brake, Dynamic Brake

### Grid Connection

Grid Tolerance	+10/-15% voltage; +/- 2Hz
Electrical Output	480 VAC, 3 phase, 50/60 Hz
Power Factor Compensation	>0.99 PF at rated
Inverter Output Reactive Power	+/- 45kVar@480V

### Braking Systems

Mechanical Brake	Main Shaft Disc Brake w/ Dual Spring Applied Calipers
Electro-Dynamic Brake	Parking and emergency backup

### Yaw System

Type	Active Upwind
Damping system	Adjustable Friction
Yaw Drive	Electrically Driven Planetary Gearbox
Yaw Bearing	Slew Ring

### Tower

Type	Tubular
Hub Height	25/32 m (82/105 ft)
Material	Steel
Corrosion Protection	Marine Paint

### Service Environment

Tower	Fully Enclosed, Ladder, Safety Climb
Nacelle	Fully Enclosed

### Controller

Type	Northern WTGS-100 Controller; Microprocessor-based
Functions	Complete Supervisory Control and Data Acquisition
Remote Control/ Monitoring Software	Integrated SmartView™ Access
Power Electronics	IGBT Pulse Width Modulation (PWM) Converter

### Environmental Specifications

Temperature Operating Range	-46°C to 50°C (-50°F to 122°F)
Lightning Protection	In Accordance with IEC 61024-1
Icing	Ice cover to 30 mm (1.2 in)
Seismic Loading	Zone 4

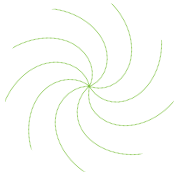
Packages available for specific site condition such as coastal environment.

### Masses

Rotor	875 Kg (1,925 lbs)
Nacelle (excluding rotor)	6587 Kg (14,513 lbs)
Tower (25m)	6500 Kg (14,330 lbs)

Northern Power Systems reserves the right to alter turbine specifications at any time.





**Northern Power designs, builds, installs and services reliable power solutions. Since 1974, we have provided turnkey energy solutions for industrial, commercial and government customers worldwide.**

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**Development**

The NW100/19 turbine was developed by Northern with support from cooperating agencies within the U.S. government, including the National Aeronautics and Space Administration (NASA); the National Science Foundation (NSF); the Department of Energy (DOE); and the DOE-funded National Renewable Energy Laboratory (NREL). Siemens-Westinghouse acted as a subcontractor to Northern in developing the innovative direct drive generator subsystem.

Turbine certification testing was carried out at the National Renewable Energy Laboratories National Wind Test Site at Rocky Flats, CO. This resulted in Type Testing Conformity Statements, for safety, loads, performance, noise, and power quality. In addition, in February 2004, the NW100/19 became the first wind turbine to receive a design conformity statement through Underwriters Laboratories (UL) to IEC 61400-1.

Northern wind turbines at the South Pole and the Antarctic coast have operated in more extreme conditions than any other turbines, including winds to 88.5 m/s (198 mph) and temperatures to -80°C (-112°F) This experience gained in harsh, remote



conditions has been incorporated into key NW100/19 design decisions affecting configuration, materials selection, performance characteristics, and deployment procedures.

**Current Installations**

The NW100 is currently installed in the villages of Kotzebue and Toksook Bay, Alaska. The Kotzebue turbine has been running successfully for over two years. The Alaska Village Electric Cooperative (AVEC) installed three turbines located in Toksook in the fall of 2005. In addition to the turbines located in Toksook Bay, AVEC has purchased seven turbines to be installed in three other Alaskan villages.

