Northern Power Systems® 2.X

Permanent Magnet Direct Drive Wind Turbine Platform

NPS 2.3 - 93 | NPS 2.2 - 100 | NPS 2.1 - 110

Northern
POWER SYSTEMS

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All turbines capture wind.

The **Northern Power** 2.X platform does it better.

A new solution for a better bottom line.

Wind turbine customers are increasingly demanding greater energy capture, higher turbine availability, reduced operation and maintenance cost, advanced grid integration capabilities, and ease of installation. We are proud to offer the Northern Power 2.X megawatt (NPS 2.X) advanced permanent magnet direct drive wind turbine platform that provides an efficient solution to address the needs of today's wind park operator. Suitable for a wide variety of sites and wind regimes, the NPS 2.X platform is offered in three rotor sizes: NPS 2.3-93, NPS 2.2-100, and NPS 2.1-110.

Setting a new standard for utility-scale wind turbine performance.

Building on our 30-year heritage of wind turbine development, the NPS 2.X wind turbine is an evolutionary design based on the Northern Power® 100 (NPS 100) and more than 50 years of cumulative field operating experience. Incorporating proprietary state-of-the-art permanent magnet generator and power electronics technology, the NPS 2.X uses advanced technology to set a new standard for wind turbine performance. The Northern Power 2.X platform delivers more power, more of the time, for a better bottom line.

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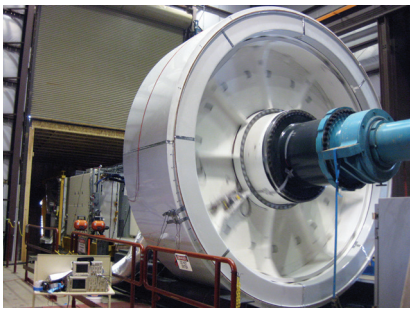


For the wind farm owner, more power means more revenue.

The Northern Power 2.X is designed with revenue in mind, producing more power with greater efficiency than similar sized gearbox driven turbines. Our advanced drive train combines a permanent magnet generator and direct drive topology, eliminating losses caused by mechanical gearboxes and generator excitation resulting in greater power capture. Full power conversion and up-tower voltage step-up means fewer electrical losses, again, translating into more power.

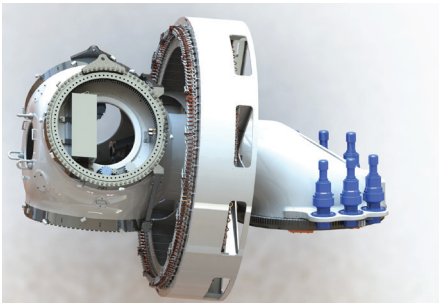
Direct Drive
In our direct drive configuration the rotor is directly coupled to the generator, eliminating the need for a separate mainshaft, gearbox and the associated losses. This increases the efficiency of power conversion and delivers greater energy production.

Permanent Magnet Generator
Permanent magnet generators are more efficient than conventional generators since they do not require excitation. Our proprietary low speed permanent magnet (PM) generator is optimized for the 2.X platform to reduce mass and cost while increasing efficiency.

Full Power Conversion
Our proprietary converter is designed for wind applications, and when coupled with our PM generator, leads to an optimized system operating at high efficiency to provide greater output. This configuration also enables integration under the most stringent utility grid codes. The 2.X meets all major grid codes for power quality, low voltage ride through, grid stabilization and dispatch control.

Up-tower Electrical Architecture
The converter and transformer are located up-tower, close to the point of generation. This reduces the electrical losses associated with transmitting low voltage down a long tower cable.

Multiple Rotor Sizes
Multiple rotor sizes means the turbine can be optimized for a particular site, offering good project economics and increasing full load hours - maximizing project energy, production and returns.



Time is money. With higher availability, less maintenance, and rapid serviceability, the Northern Power 2.X generates electricity – and revenue – more of the time.

The NPS 2.X's simple architecture means greater reliability and less downtime. With its direct drive power train and fewer moving parts, your NPS 2.X will never have unscheduled maintenance due to gearbox failure and planned maintenance is reduced to just once a year. The permanent magnet generator spins 100 times slower than traditional generators, reducing wear and potential downtime. Full power conversion isolates the turbine from potential grid events that could take the turbine offline. It all adds up to the Northern Power 2.X generating electricity more of the time by design.

›› Simple Design

Our direct drive architecture minimizes part count and enables an efficient load path. This increases reliability and reduces tower head mass. There are only two low speed bearings in the drivetrain as opposed to nearly two dozen in gear-driven designs. This means competitive cost and increased availability.

›› Proven Design

- All criticial subsystems have undergone rigorous testing, including full-scale testing of the drivetrain on the US Department of Energy dynamometer
- The NPS 2.3-93 has been thoroughly tested to IEC standards and is Type Certified

›› Designed for Serviceability

- The main power components are serviceable without a ground-based crane, reducing costs and wait times
- The modular design provides low transport and lift weights, thereby reducing operating cost
- Accessibility of components has been considered in the design and speeds service operations if needed

Your project's success is dictated by the bottom line.

The Northern Power 2.X maximizes project success by delivering a competitive installed cost, fewer forced outages, rapid serviceability and lower operating cost. Your NPS 2.X will generate more power, more of the time, for a better bottom line.

›› **Competitive Installed Cost**

The NPS 2.X has the same tower top weight as conventional gearbox driven turbines and is 30 percent lighter than wound rotor direct drive wind turbines. This means the NPS 2.X can be installed with the same size crane and similar foundation as traditional, comparable sized wind turbines resulting in a competitive installed cost.

›› **Increased Energy Capture**

The high efficiency of the permanent magnet direct drive design increases energy capture, while the reduction in parts and components reduces failure rate and so improves reliability and availability.

›› **Lower Operating Costs**

Higher reliability means lower part failure rate and related repairs; the on-board service features and crane speed up repairs thus lowering costs while providing greater up-time.

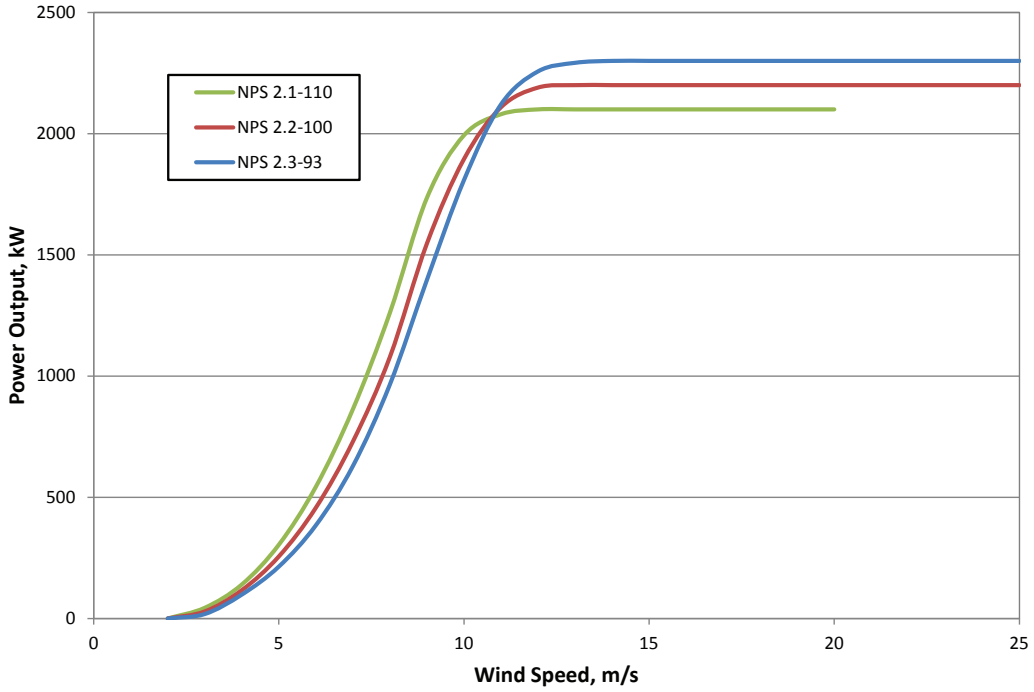
This translates into lower total cost of ownership, increased revenues and a greater return on investment.

Northern Power 2.X Platform Specifications

Model	Northern Power® 2.3-93	Northern Power® 2.2-100	Northern Power® 2.1-110
Design Class	IEC IIA	IEC IIIA	IEC IIIB
Rated Electrical Power	2300 kW	2200 kW	2100 kW
Rotor Diameter	93 m	100 m	110 m
Hub Height	80 m / 98m steel	80 m / 98m steel; to 120 m concrete	80 m / 98m steel; to 120 m concrete
Cut-In : Cut-Out Wind Speed	⟨3.0 m/s : 25 m/s	⟨3.0 m/s : 25 m/s	⟨3.0 m/s : 20 m/s
Nominal Grid Connection Voltage	Application specific, 10-34.5kV		
Nominal Grid Frequency	60/50 Hz		
Power Regulation	Variable speed, pitch controlled		
Drivetrain Type	Gearless, Direct Drive		
Generator Type	Permanent Magnet		
Converter Type	Full rated IGBT power converter; modular architecture		

For detailed information, request the NP 2^{+} Specifications Sheet. All specifications subject to change without notice.

Northern Power 2.X Platform Power Curves



Northern Power Systems is a fully integrated company that designs, manufactures, and sells wind turbines into the global marketplace from its headquarters in Vermont, USA, with European headquarters in Zurich, Switzerland and a significant presence in the United Kingdom and Italy. Northern Power Systems has over 30 years of experience in developing advanced, innovative wind turbines. The company's proven, next generation wind turbine technology is based on a vastly simplified architecture that utilizes a unique combination of permanent magnet generators and direct-drive design. This proven approach uses fewer moving parts, delivers higher energy capture, eliminates drive-train noise, and provides increased reliability due to reduced maintenance and downtime.

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