VESTAS V-15 RECONDITIONED WIND TURBINE INFORMATION

PRICING **Call Bruce to order yours 1 904 513 1418**

- 65kW (480VAC, 3-phase, 60Hz) price $34,900 + Shipping
- 50kW (480VAC, 3-phase, 60Hz) price $34,900 + Shipping

• Call for units prices with out installation fee attached
- Prices include rotor, tower, nacelle, controller, foundation plans, Not included is foundation.
- Prices subject to change without notice supply going fast.

Description of Vestas V-15 (65kW) Wind Turbine

Each turbine consists of a three-bladed, fixed pitch, up-wind rotor assembly mounted on a horizontal steel drive shaft supported by large bearings. The drive shaft is connected to a Vestas-developed twin induction generator system located in the turbine nacelle through a step-up gear assembly. All machinery necessary for the production of electricity, yawing, and braking is contained in the nacelle. Each turbine is mounted on a 74' steel lattice tower to minimize wind turbulence caused by ground topography. The entire turbine assembly, including the rotor and tower, weighs approximately 16,700 pounds.

The rotor blades are constructed of reinforced fiberglass and are bolted to a central hub. The hub has been designed and manufactured by Vestas to allow the pitch of each blade to be adjusted on site at a fixed angle to the hub that optimizes individual turbine performance. When assembled, the rotor has a diameter of 15.3 meters (approximately 50 feet) and rotates at speeds ranging from 42.2 to 53.6 RPM.

Each turbine contains an electronic controller that monitors the functioning of the turbine, automatically switching the turbine from the power grid and activating the hydraulic braking system in the event of a malfunction.

The turbine is designed to generate electricity in wind speeds as low as 8.9 mph and continues to generate electricity at wind speeds up to 62 mph. Power production is maximized over the turbine's wind velocity operating range through the use of two induction generators. The small generator is rated at 12.6 kW and operates at wind speeds ranging from approximately 8.9 mph to 15.7 mph. The large generator is rated at 65kW and operates in wind speeds ranging from approximately 15.7 mph to 62 mph. The turbine's controller automatically switches between the two generators depending upon wind speeds and rotor revolution rates. When wind speeds exceed 62 mph, the generators are automatically taken off-line from the power network and the braking mechanisms bring the rotor to a halt. The turbine then waits for the wind to return to production speeds and automatically restarts.

Each turbine contains an independent yaw control system designed to control turbine rotation around its vertical axis and to position the turbine so that it is aligned perpendicular to the maximum wind flow and the rotor faces into the wind. As wind direction shifts, a wind direction indicator mounted on top of the turbine activates the yawing system that rotates the turbine to maintain optimum alignment of the rotor into the wind. The yawing system operates independently of the main turbine rotor and generating system.

The turbines operate with a fixed pitched rotor which, due its design, automatically stabilizes rotor speed over a wide range of wind speeds. Each turbine is also equipped with a hydraulic braking system that can be activated by the controller or by push buttons at ground level and in the nacelle.

System Specifications (Summary)

TOWER
Lattice mast
74 ft high
Hot-galvanized surface

OPERATIONAL DATA
Cut-in windspeed:8.9 mph
Cut-off windspeed: 62.0 mph
Survival windspeed: 100 mph

ROTOR
50 ft diameter
53.6 or 42.2 rpm rotational speed
Upwind orientation

GENERATORS
Induction generators
Ratings: Main generator: 65 kw
Small generator: 12.6 kw
480 VAC; 3-phase; 60 Hz

YAWING SYSTEM
Control: Windvane (electronic)
Yawing speed: 72 degrees/min.

BLADES
Glasfiber reinforced polyester
1972 ft?swept area
Centrifugal force activated tip brakes

MISCELLANEOUS
Entire Assembly (Turbine, rotor, tower) weighs approx. 16,700 lbs.
Blades are fixed, but pitch can be adjusted to optimize performance for your site
Controller monitors turbine function and automatically shuts down in event of malfunction
In winds > 62mph, generator is taken off power network and brakes bring rotor to halt

Requirement to be connected to Utility Grid

These turbines must be connected to an electric utility grid. A significant advantage of this connection can be a special metering and billing arrangement called net metering with your Electric Service Provider (ESP).

If your ESP approves this, net metering is the way in which you sell your extra power to the ESP. When your turbine produces more electricity than you need, the excess flows to the grid and turns your meter backwards. This net (subtracting from you usage) metering allows you to get retail value for some, if not all, of the electricity your turbine produces. Most ESPs will buy your excess power, but the rates vary by location.

You need to contact your ESP to find out their requirements for a parallel generator (this is when you are both a producer and a consumer of electricity). For everyone's protection some grid inter tie control will be required. You may be required to install a locking disconnect switch for the wind turbine next to your kilowatt- hour meter. We will supply a block diagram of the major system components. An electrical schematic showing how your turbine is connected, depending on local condition, can be added by you or your contractor. Also, the ESP may ask you to carry liability insurance. This can be added to your homeowners policy.

Wind Speed and Performance Estimates

We suggest the turbines be operated in an area with at least 12 mph (near the ground, 14 mph at turbine height) annual average wind speed. You may be able to obtain wind speed information from a local airport or weather bureau. Keep in mind that if the local airport monitors the wind speed at 20 to 30 feet above ground, the actual wind speed at 75 ft. elevations may be 2 to 4 mph higher. Normally the wind speed increases as we move away from the surface of the earth.

The calculation of the estimated energy production of the turbines depends on the power output of the turbines at various wind speeds (the "Power Curve"), the expected wind conditions at the operating site, and the estimated turbine availability rate and power transfer line losses.

Based upon the operating data of 157 of these V15 turbines and the engineering data supplied by

Vestas, the following Power Curve for the V15 turbine was developed by Vestas:

PERFORMANCE ESTIMATES

Wind Speed (mph)	Power Output (kW)
0 - 8.9	0
10	4
15	12
20	26
25	50
30	61
35	68
40	71
45	68
50	65
55	65
60	63

Actual output varies with air density and turbulence. Reduction of power output at speeds in excess of 40mph is due to the designed stall characteristics of the rotor blades.

Distributor , Inc. makes no representations or warranties, express or implied, regarding the power curve or power output of these turbines. However, an independent test performed on a number of the V15 turbines at Distributor 's Tehachapi site under a number of different wind conditions indicated that the turbines performed at or above the power production levels estimated above.

Installation and Servicing

In order to operate properly the Vestas turbine requires a substantial foundation. Distributor will provide sample foundation drawings at the time of purchase, but actual foundation requirements will vary with the characteristics of the site you have chosen for installation.

Servicing the turbines is rather simple. Distributor provides manuals and blueprints at the time of sale. For future needs, technical phone support or on-site training can be purchased for a reasonable fee.

Distributor provides a one-year parts warranty (from date of purchase) for major components (gearbox, main generator, yaw system). After it is received from purchaser, Distributor will replace the bad major component. Purchaser is responsible for shipping costs.

Since these turbines have always been well maintained over the years, they run very well so we do not expect any major problems with them. A description of the process we use for reconditioning the units prior to sale is provided below.

Description of the Reconditioning Process

- **All parts**: Inspect / replace as needed.
- **Gearbox:** Check for backlash and endplay. Replace seals if leaking.
- **Brake unit:** Pressure test. Replace pads, leading lines (hoses), rebuild brake caliper - as needed. Meg and test brake motor.
- **Yaw system:** Meg and test yaw motor. Inspect yaw gearbox, fill with fluid. Inspect, adjust slide shoes, or replace if needed
- **Generator:** Disassemble both generators, re-dip armatures, replace bearings. For small generator, check, adjust or replace belts. Test and adjust RPM sensor.
- **Main shaft**: Inspect bearings and seals. Check for wear and end play.
- **Anemometer:** Test anemometer and windvane.
- **Controller:** Tighten all terminations and test.
- **Blades:** Inspect tips, replace bushings, pins, if needed. Balance blades to each other.

TO ORDER A TURBINE OR FOR FURTHER INFORMATION, PLEASE CONTACT:

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