



LADCO Advanced Engineering Ltd

Briefing Document

LES6000 Small Wind Turbine

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1. INTRODUCING THE LES6000

The LADCO Energy Systems 6kW wind turbine is a 3 bladed, horizontal axis, upwind small wind turbine suitable for domestic or light industrial use. The turbine is currently under development and is a continuation of the project begun in 2007 by Ritchie's of Forfar, the well-known agricultural equipment manufacturer, and will become available later in the year once performance and reliability testing trials are complete.

The LES6000 turbine incorporates novel technology for its class size, utilising control principles more commonly associated with utility sized wind turbines. The system is grid connected via an inverter so that excess power generated by the turbine can be exported to the National Grid. An intelligent machine control system is used to monitor the prevailing wind speed and its direction, the speed of the turbine's rotation, and also the status of the inverter and grid connection. The software within the control system monitors these parameters and controls the turbine to maintain optimum power production.

One of the systems key features is an active yaw system, which uses information on the wind's speed and direction to turn the turbine out of the wind when the wind conditions become too severe. This reduces the amount of power that the blades collect from the wind, and allows the turbine to continue producing its maximum power output, even when the wind is much stronger than is required for the system to produce maximum power.

The turbine is supplied on either a 10m or 15m tall galvanised steel tubular tower which is hydraulically actuated for easy raising and lowering of the turbine nacelle during installation or periodic maintenance.



2. BENEFITS OF THE LES6000 SYSTEM

Description	Value
Cut In (m/s)	3
Lowest generative speed (m/s)	2
Cut Out (m/s)	17
Survival (m/s)	110
Rated (m/s)	10
Rotor Type	Horizontal
Number of Blades	3
Blade Material	Advanced GRP Composite
Rotor Diameter (m)	5.4
Generator Type	Fixed Shaft Permanent Magnet
Battery charging	no
Grid connect	Yes via Inverter
Control System	Electronic control incorporating wind speed, wind direction & turbine RPM sensors. Incorporates push-button start/stop interface. Automatic start up & shut down.
Direct Heating	No
Rated RPM	240
Head Weight (kg)	180
Mast Type	Self Supporting (Hydraulic)
Hub Height (m)	10 or 15
Foundation (m)	2.4 x 2.4 x 1.5
Winch Found (m)	Not required
Tower Weight (kg)	1800Kg
Electrical Brake	PWM Electronic Brake
Mechanical Brake	Not required
Rotor Thrust (kN)	4.9

- Highly efficient PMG and power matched inverter, tested by TUV.
- Highly efficient, lightweight GRP blades, tested by Strathclyde University.
- Control system – Intelligent controller gives system awareness of wind speed, wind direction in relation to turbine axis, rotor rpm, grid availability and power exporting. Factory built and subjected to a 100 point test and quality check.
- Safety – because the system knows about its environment and turbine speed, it can shut down in high winds and restart itself once the strong winds have decayed.
- Safety – The system shuts down in a controlled manner in the event of a power cut or if commanded to by pressing the stop button.
- Safety – the system employs a brake load to keep the turbine running at its design rpm for maximum power even when gusts pass through.
- Control enclosure located at base of tower. Minimal disruption and space required at point of connection to electricity supply.
- Integrated Inverter unit – converts power from generator into mains frequency and voltage. This unit monitors the electricity supply and disconnects the turbine from the grid in the event of a power cut.



- Active Yaw system – an electric gear motor system turns the blades into or away from the wind
- Fixed shaft permanent magnet generator – the windings are stationary. The magnets spin around the windings and is unlikely to fail.
- Hydraulically actuated self-supporting tower. Can be located on “dead land”. Simplifies maintenance – can be carried out by one person, involving less effort and time.
- Simple to install. Turbine nacelle fully assembled in factory requiring minimal on site work. Simple electrical terminations.
- High efficiency means that the LES6000 can generate as many units of electricity as some of our competitors’ larger products.
- The blades start turning at 2.5m/s (5.5mph) and start producing usable electricity at 4m/s (9mph). They keep producing electricity up to 18m/s (40mph). This is a wider operating spectrum than most other competing equipment.
- Maximum power output of 6.0kW reached in 10 m/s (22mph) wind. This is lower than most other manufacturers’ equipment, which means the LES6000 reaches maximum power more often.
- A complete kit of parts is supplied on 3 pallets + tower. All that required to be supplied is concrete for the foundation and SWA cable to connect the control panel to the electricity supply.



3. FAQs

3.1 BASICS OF WIND ENERGY GENERATION

- How does the diameter of the blade set affect a wind turbine's performance? The circular area that the blades move through is called the swept area. The bigger the blade swept area, the more power the blades can harvest from the wind.
- How does the height of the tower affect a wind turbine's performance? As wind speed increases with height, the higher the turbine is mounted, the more power it will generate in comparison to another turbine mounted at a lower height.
- How does wind speed affect a turbine's performance? The power available in the wind is related to the cube of the wind speed. If you double the wind speed then you get 8 times the power e.g. $2^3 = 2 \times 2 \times 2 = 8$
- What is Wind Speed Distribution? This is the annual pattern of wind speeds that exist at a given site. It's a profile of how frequently the wind blows at different speeds over the course of a year.
- Do obstructions affect wind turbines? Trees, houses, silos all affect wind flow up to 15 times the height of the obstruction away from the obstruction. Wind turbines should ideally be located on open flat land.
- What's the difference between power and energy? Power is the instant output of a system, e.g. 6kW (kilo-watts) and energy is the amount of power measured over a period of time e.g. 6kWh (kilo-watt-hours). If a turbine produces 6.0kW of power continuously over an hour it has generated 6.0kWh of energy. This is the same as 6 Units of electricity.
- What is a power curve? This is a graph showing the relationship between the wind speed and the instantaneous power that a generating system produces.

3.2 PERFORMANCE

- What is a unit of electricity? A unit of electricity is the equivalent of consuming 1 kilowatt of power for 1 hour. 1 unit is the same as 1 kilowatt hour (kWh). Power is an instantaneous measurement, whereas energy is a measure of power over a period of time.
- What happens in the event of a power cut? The LES6000 is a grid tied system which means that it needs the grid supply to be present to operate. So that engineers working to repair the electrical fault are not put at risk, the inverter disconnects from the grid and the turbine will shut down in a controlled manner. This means that you are not self-sufficient in the event of a power cut.
- What is the maximum power output of the LES6000? The LES6000 will output a maximum of 6.0kW and is delivered on a single phase.
- What are the operating wind speeds of the LES6000? The LES6000's blades will begin to turn when the wind blows at 2.5m/s (5.5mph) and start producing usable electricity at 4m/s (9mph). They keep producing electricity in sustained winds up to 17m/s (38mph) but can handle transient gusts up to 25m/s (56mph)
- What can I do with the extra electricity that my turbine produces that I don't use? It is recommended that you enter into a contract with your electricity supplier so that you get paid for the energy that you export onto the grid. The market for microgeneration produced energy is becoming increasingly competitive and it's recommended that you shop around for the best deal.
- How do I know how much energy my turbine has produced? In the top left hand corner of the control panel, there is an energy meter which measures the number of units produced over the turbine's life.
- How do I know that my turbine is producing power? The controller in the centre of the control panel has an LCD display, which provides real-time information on the system's status.
- How can you predict what the energy generated at my site will be? An online national database exists which provides an indication of the average wind speed for the kilometre square grid in



which your property lies, on the Ordnance Survey's Landranger map range. This average wind speed can then be used to create a statistical profile of the wind resource in that square. The power characteristics of the LES6000 can then be superimposed on that wind profile to arrive at a prediction for the energy that will be generated. Of course, the actual value generated may be higher or lower than the prediction indicates.

- How do I know if my site is suitable? The first step is to determine the average wind speed for your site. If this is high enough to generate a reasonable amount of energy, then a site visit by an approved installer is recommended to determine that the site is free from wind obstructions and to identify potential planning issues.
- What happens if I generate more energy than I use? If the load at your site is less than the energy being produced by the wind turbine, then the additional energy is automatically exported on the Grid.

3.3 DESIGN

- How does the LES6000 regulate its speed? The LES6000 knows how fast the turbine blades are spinning. If the blades momentarily attempt to spin faster than the maximum rpm due to gusting winds, then a brake load is deployed to slow the blades down. If the wind speed has increased beyond the level for generating maximum power, then the turbine points itself out of the wind so that not as much of the wind's energy is harvested.
- Why doesn't the LES6000 have a tail? The LES6000 employs large wind turbine technology to sense how fast the wind is blowing and from what direction. Knowing where the wind is coming from, the LES6000 uses an electric gear motor to move the turbine nacelle around the tower, pointing the blades either into or out of the wind as required.
- Why are there 3 blades on the LES6000? 3 is the minimum number of blades which gives the most stable and balanced mechanical arrangement. 2 blades can set cause the tower to oscillate at certain wind speeds.
- Can I monitor the output of the LES6000?. A kilowatt hour meter is mounted on the control panel to record the amount of energy the system has produced.
- What measures have been take to make the LES6000's controls secure from theft, vandalism, etc? The LES6000's control equipment is housed within a steel enclosure which incorporates a 3 point locking mechanism and a key lock.
- How safe is the LES6000? All of the LES6000's systems are designed to fail safe. If the grid fails, or the wind speed increases to severe gale force or the turbine over speeds, the system shuts down in a controlled manner and parks itself. Additionally, the system and its components have been thoroughly tested in both laboratory and field conditions.

3.4 INSTALLATION & MAINTENANCE

- What tasks are involved in installing the LES6000? A foundation put must be dug and anchor bolts suspended over the pit while it is filled with concrete. Once this has set, the tower can then be placed onto the anchor bolts and secured. The turbine nacelle can then be fitted and fastened on with 2 bolts, which then requires the blades and none cone to be assembled. 2 wires also need to be run up the tower and terminated at both the turbine nacelle and in the control cabinet. A cable to connect the control panel to the electricity supply to convey the electricity produced is also required.
- How long does it take to install the LES6000? Digging the foundation pit, setting the foundation anchors and filling the pit with concrete can be done in one day. The concrete should be left to harden for a minimum of 10 days. The placement of the tower and the fitting and installation of the nacelle can be done in a further day.



- What materials are required to install the LES6000? With the exception of the concrete to form the foundation and the cable to connect the control panel to the electricity supply, all materials required to install the turbine are supplied?
- How complicated is it to connect the LES6000 to the grid? It is extremely straightforward to connect the LES6000 to the grid and all that is required is a spare slot on your existing consumer unit. Should one not be available, a secondary consumer unit will have to be fitted.
- What maintenance does the LES6000 require? It is recommended that the LES6000 be serviced once every 2 years. This can be carried out quickly and efficiently by 1 person and involves checking that all fasteners are secure and that there are no signs of fatigue.
- Is planning permission required to install the LES6000? Yes. You must obtain permission from your local authority before beginning any work to install the LES6000.
- Do I have to tell my electricity supplier that I've installed a LES6000? You need to inform your local Distribution Network Operator (DNO), who are the people who own the wires in your area. You need to inform them what you intend to connect to their network. If you want to receive payment for the electricity that you export onto the National Grid, then you also need to enter into a contract with a supplier who has an appropriate supply package that recognises microgeneration.
- How far away from dwellings should the turbine be situated? The turbine should be installed far enough away that noise from the turbine can't be heard inside the dwelling, but not so far away as to significantly increase the installation cost from having to run long cables to the dwelling consumer unit. This will typically be in the region of 50 – 100m.

3.5 COMMERCIAL

- Some companies hire out wind turbines. Can I hire a LES6000? There are no plans at the moment to hire out LES wind turbines.
- Are grants available for the LES6000? Grants are available through the Rural Development Programme for up to 60% of a project's cost.
- How quickly will the LES6000 pay for itself? Without taking into account RDP grants, in an average wind regime, with an annual energy demand of 6000 units, the LES6000 will pay for itself inside 8 years.
- What warranty is offered with the LES6000? A manufacturer's 2 year warranty is provided as standard.
- What items are covered by the warranty? All of the system's components are covered by the manufacturer's warranty during the first 2 years of service.
- How can I calculate if the LES6000 will save me money? A prediction of the annual energy that the LES6000 is likely to generate from the installation site's average wind speed can be made. This prediction is based upon measured performance data for the turbine and statistical distribution of the sites wind speed. This information can then be compared against your annual energy consumption.
- How long will it take for the LES6000 to pay for itself? The length of time that it takes for the LES6000 to pay for itself is dependent upon the installation site's wind speed. Turbines on sites with higher average wind speeds will pay for themselves faster.