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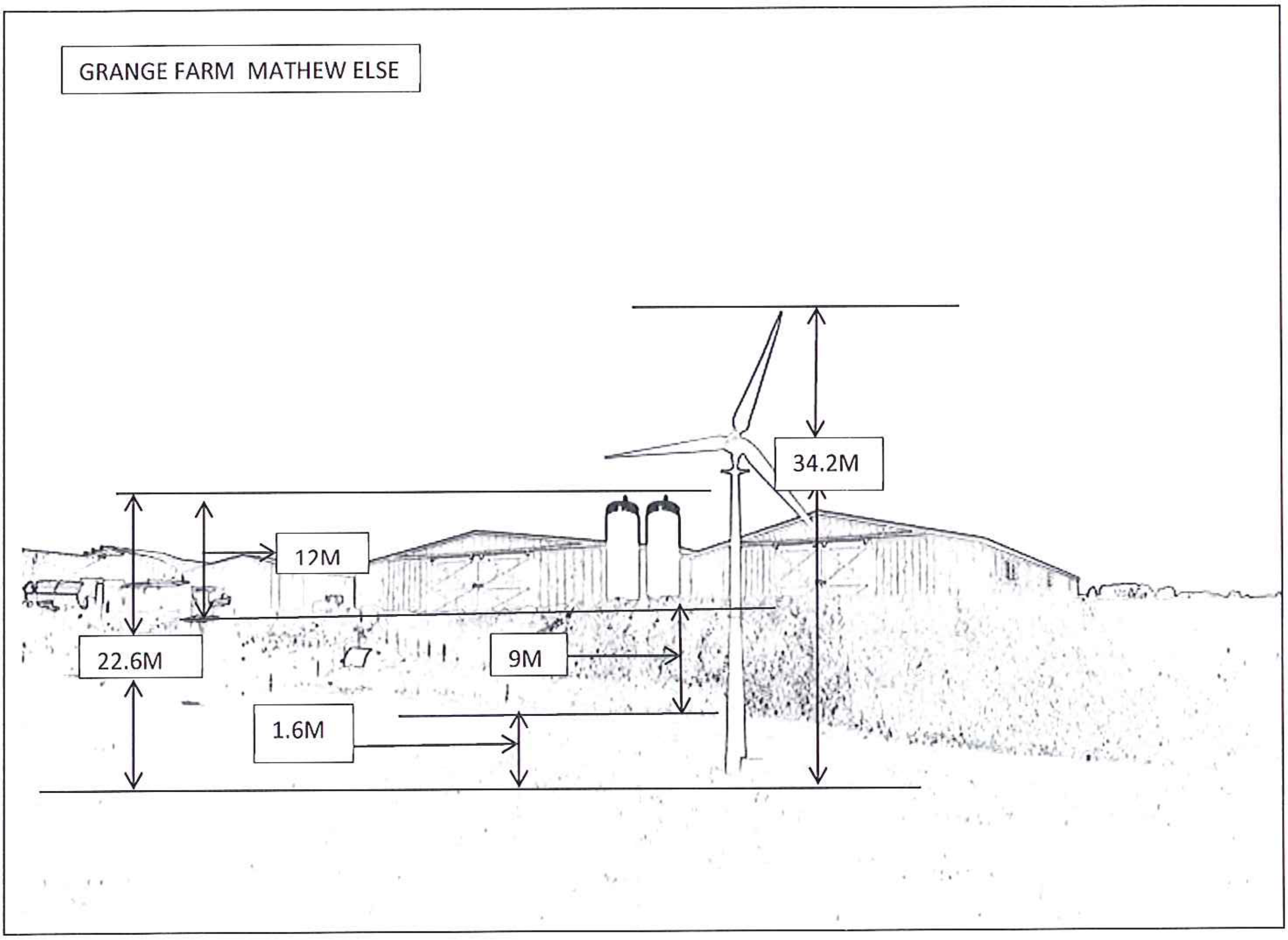
ES Renewables Ltd



LINE DIAGRAM MATHEW ELSE GRANGE FARM STAINTONDALE

TOTAL HEIGHT FROM TOWER BASE TO FEED BIN TOP IS 22.6 METRES PLUS 50% = 33.9. METRES WHILST THE TURBINE BLADE TIP HEIGHT IS 34.2 METRES.

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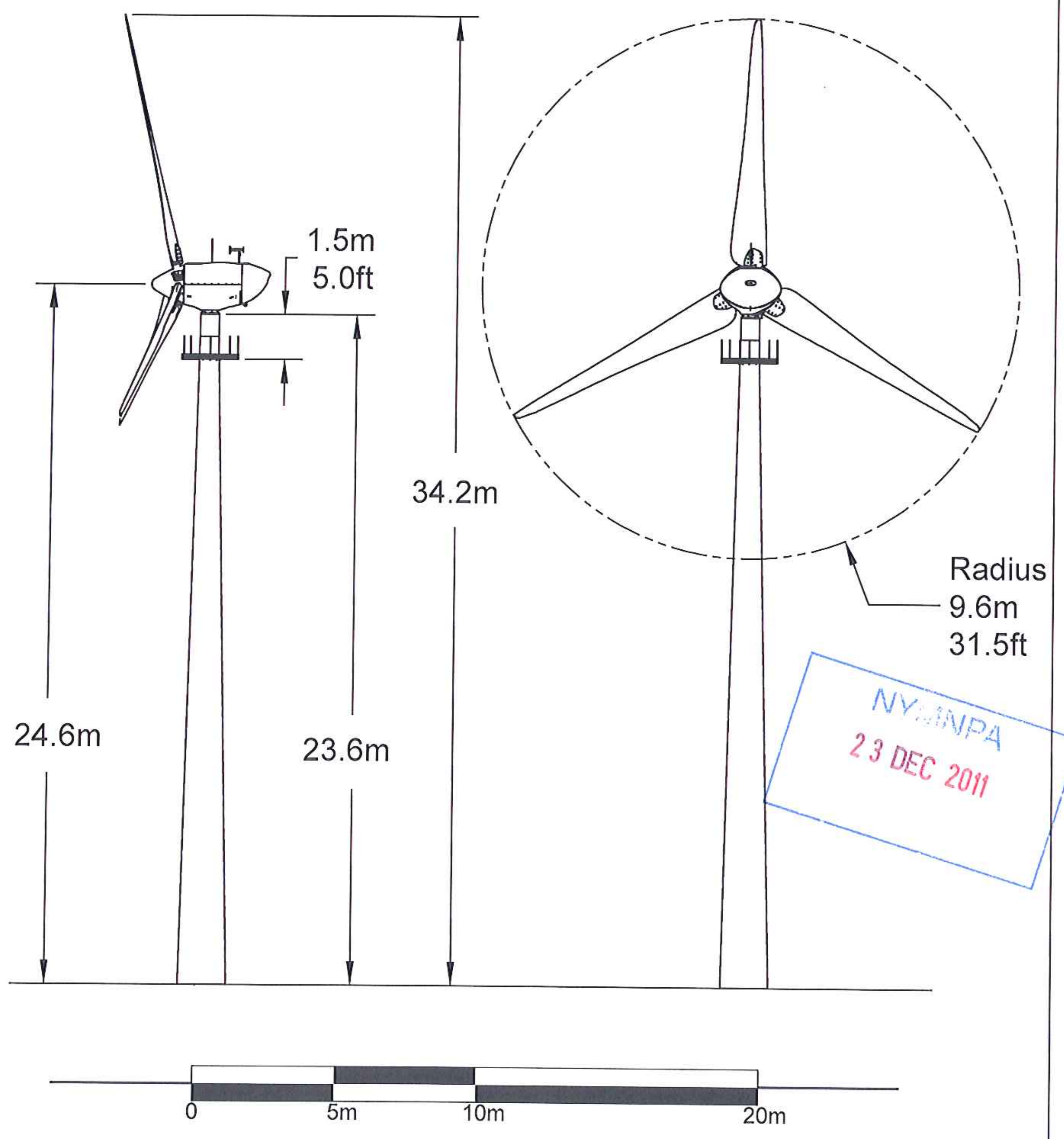

Flange Elevation		Hub Elevation		Max Blade Elevation		Notes
ft	m	ft	m	ft	m	
77.4	23.6	80.7	24.6	112.2	34.2	EU Countries Only
97.1	29.6	100.4	30.6	131.9	40.2	North America Only
116.1	35.4	119.4	36.4	150.9	46.0	North America Only
135.8	41.4	139.1	42.4	170.6	52.0	North America Only

Note: Dimensions approximate and provided for planning purposes only. Final construction elevations are available in a permitting package on a per-tower basis.

Endurance wind power

E-3120 Elevation

SIZE	DWG NO	REV.
A	E-3120 - 50 kW Monopole	A

Connection of generation plant to distribution networks

It is possible to connect almost any generation plant to the distribution network and in order for the connection to meet the requirements of a new customer and the existing customers it is important to ensure the new connection is properly designed. In order to do this there is a need for information to be exchanged between you as the generator and the local Distribution Network Operator (DNO). The Data Registration Code of the Distribution Code sets out the obligations on the generator and DNO to exchange data as part of the design process and lists the data items that may need to be exchanged. The purpose of this application form is to simplify and clarify this data exchange process.

If the generation plant that you are applying to connect is less than 16A per phase, you will probably be able to connect it using the far simpler connection process for generation plant complying with Engineering Recommendation G83/1.This Application Form is for all other generators and is in two parts.

Part 1

This part collates the initial data that the DNO requires to assess the connection application and in some cases this information may be sufficient for the DNO to complete the connection design and make a connection offer. In this case there will be no need for you to provide additional information. However, for some generating plant connection applications, depending on the size of the generating plant and the proposed point of connection, this initial information may not be sufficient for the DNO to complete the connection design and make a connection offer. The DNO will advise you if you need to provide further information so that the connection design can be completed when Part 1 of the Application Form has been assessed by the DNO.

Part 2

If the DNO requires information in addition to that provided on Part 1 of the application form, the DNO will request that Part 2 of the application form is completed. Generally you will need to complete all of Part 2 of the application form appropriate to the type of generator although the DNO may indicate if not all of this information is required.

In some cases the DNO will require further information which is not included in either part of the application form to complete the connection design. The DNO will advise you if such information is required.

There is the option for you to complete Part 1 and 2 of the application form and return both of these as part of the initial data exchange. This will speed up the DNO design process as there is unlikely to be a need for additional information to be provided. However this may result in you providing information that is not required in order for the DNO to design the connection.

The application forms can be downloaded from the ENA website and when completed they should be sent to your local DNO. Their contact details can be found by following the link below:

http://2009.energynetworks.org/members/

If you are unsure of who your local DNO is, please follow the link below to do a postcode search.

http://www.energynetworks.org/01/map_elec_suppliers_postcode_large.asp

Guidance on completing the application form

The following section provides an overview of the information required to complete each part of the application form.

Part 1

This part of the application form is in two sections. Part 1a enables you to provide:

- Contact details for you and your consultant (if you have one)
- The location of your generation plant, or power station. The term power station is used in the application form so that it is consistent with the terms used in the Distribution Code
- Details of the import and export requirements for your site. It is important to make sure that you consider the import requirements for any load that you have on your site in addition to the export from the generation plant
- Information about the fault level contribution from the generation plant at the site boundary, although you do not need to provide this information here if more detailed fault level information is provided in Part 1b of the application form.

Part 1b of the application form enables you to provide more detailed information on each of the generators you are applying to connect. Slightly more information is required if the connection is likely to be at high voltage rather than at low voltage. If the generation plant you are looking to connect is larger than 150kW you should assume that your site may be connected at high voltage and provide this additional information.

If there are any items on the application form that you are unsure about, it would be worth contacting the company you are arranging to buy your generation plant from as they should be able to provide some of the more technical information. If you are unable to provide some of the technical details for example if you have not yet decided who to buy your generation plant from, you can provide estimated data provided that you clearly indicate on the application form which data is estimated. You will need to confirm this data as soon as possible and always before the generator is commissioned.

Part 2

This part of the application form enables you to provide detailed technical information about the generation plant you are applying to connect. It is split into five sections. The first four sections relate to particular types of generating plant designs. You only need to complete the section relating to the type of generating plant that you are applying to connect i.e. Part 2a, 2b, 2c or 2d. Use one form for each type of generating plant. The fifth section enables you to provide information about any transformers that you plan to use.

As when completing Part 1, if you are unable to provide some of the technical details, if for example you have not yet decided who to buy your generation plant from, you can provide estimated data provided that you clearly indicate on the application form which data is estimated. You will need to confirm this data as soon as possible and always before the generator is commissioned.

------------------------------ PART 1a ------------------------------

Applicant's Details

Company Name: ES Renewables Ltd.

Company registered No.: 6861255

Postal Address: 52 Caledonia Street, Scarborough

Contact Name: Mr Robert Dixon

Email Address: rob@esrenewables.co.uk

Telephone No.: 01723 584276

Fax No.: ______

Consultant's Details (if applicable)

Consultants Name: ES Renewables Ltd

Postal Address: 52 Caledonia Street, Scarborough, North Yorkshire, Y012 7DP

Contact Name: Peter Griffiths

Email Address: esrenewables.co.uk

Telephone No.: 01723 584276

Fax No.: ______

Power station location and operation

Power station name: _E3120

Postal Address or site boundary plan (1:500): As above; _See attached maps

Details of any existing Connection Agreements: New connection

Target date for provision of connection / commissioning of power station: July 2011

------------------------------ PART 1a ------------------------------

Connection Point (OS grid ref or description): ______

Preferred connection point voltage: **400 V**

Single line diagram of any on-site existing or proposed electrical plant or, where available, operation diagrams: Please attach

What security is required for the connection? (see note A1): **N/A_**

No. of generation sets in power station: ______

Are all generation sets of same design/rating? ______ Y/N

Will power station operate in island mode? ______**No**______ Y/N

Will generation plant supply electricity to on-site premises? ______**Yes**______ Y/N

Power station standby import requirements (see note A2)

Maximum active power import: **0.008 MW during motoring**

Maximum reactive power import (lagging): **0.014 MVAr (inductive) during motoring**

Maximum reactive power export (leading): ______ MVAr

Power station top-up import requirements (see note A3)

Maximum active power import: ______ MW

Maximum reactive power import (lagging): ______ MVAr

Maximum reactive power export (leading): ______ MVAr

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----------------------------- PART 1a -----------------------------

Power station export requirements (see note A4): Total power station output at registered capacity (net of auxiliary loads)

Registered capacity (maximum active power export)	0.090 MW (max 1 min average)
Maximum reactive power export (lagging)	____________ MVAr
Maximum reactive power import (leading)	0.03 MVAr (inductive)

Power station maximum fault current contribution (see note A5)

Peak asymmetrical short circuit current at 10ms (i_p) for a 3φ short circuit fault at the connection point	See sect 1b
RMS value of the initial symmetrical short circuit current (I_k'') for a 3φ short circuit fault at the connection point	____________ kA
RMS value of the symmetrical short circuit current at 100ms ($I_{k(100)}$) for a 3φ short circuit fault at the connection point	____________ kA

Power station interface arrangements (see note A6)

Means of connection, disconnection and synchronising between the DNO and the Customer

When wind starts, turbine is motored at low power using a soft-start thyristor circuit.

When wind is adequate for generation, soft-connection thyristor circuit connects generator to mains.

Disconnection occurs for low wind, turbine fault, or grid fault as sensed by G59 interconnection relay.

Induction generator is self-synchronizing.

Note A1 – The DNO will assume a single circuit connection to the power station is required unless otherwise stated. Options include:
(a) single circuit connection
(b) manually switched alternative connection
(c) automatic switched alternative connection
d) firm connection (secure for first circuit outage)

Note A2 – This section relates to operating conditions when the power station is importing active power, typically when it is not generating. The maximum active power import requirement and the associated maximum reactive power import and/or export requirements should be stated

Note A3 - This section relates to operating conditions when the power station is importing active power, typically when it is generating, but is not generating sufficient power to cater for all the on-site demand

Note A4 – This section relates to operating conditions when the power station is exporting active power. The active power export and associated maximum reactive power export and/or import should be stated for operation at registered capacity.

Note A5 - See Engineering Recommendation G74, ETR 120 and IEC 60909 for guidance on fault current data. Additionally, fault current contribution data may be provided in the form of detailed graphs, waveforms and/or tables. This information need not be provided where detailed fault level contribution / impedance data is provided for each Generation Set in Part 1b or Part 2 of this application form

Note A6 - The interface arrangements need to be agreed and implemented between the User and DNO before energisation. DPC7.3.1 of the Distribution Code refers.

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---------------------------------- PART 1b ----------------------------------

Generation set general data

Number of generation sets to which this data applies ____________________

Type of generation set (please tick box)

- Synchronous generator ☐
- Fixed speed induction generator X
- Double fed induction generator ☐
- Series converter / inverter connected generator ☐
- Other (provide details) ☐

Type of prime mover: Wind

Operating regime (see note B1). Please tick box

- Intermittent X
- Non-intermittent ☐

Generation set Active Power capability

Rated terminal voltage (generator)	400 V
Rated terminal current (generator)	133 A
Generation set registered capacity (net)	0.090 MW (1 min ave)
Generation set apparent power rating (to be used as base for generator parameters)	0.095MVA
Generation set rated active power (gross at generator terminals)	0.080 MW (maximum continuous)

Generation set Reactive Power capability at rated Active Power (gross, at generator terminals)

Maximum reactive power export (lagging). For HV connected generators only	N/A
Maximum reactive power import (leading). For HV connected generators only	N/A

Generation set maximum fault current contribution (see note B2)

Peak asymmetrical short circuit current at 10ms (I_p) for a 3φ short circuit fault at the generation set terminals (HV connected generators only)	N/A
RMS value of the initial symmetrical short circuit current (I_k'') for a 3φ short circuit fault at the generation set terminals (HV connected generators only)	N/A
RMS value of the symmetrical short circuit current at 100ms ($I_{k(100)}$) for a 3φ short circuit fault at the generation set terminals	~0.8 kA

Note B1 – Intermittent and Non-intermittent Generation is defined in Engineering Recommendation P2/6 as follows: Intermittent Generation: Generation plant where the energy source for the prime mover can not be made available on demand. Non-intermittent Generation: Generation plant where the energy source for the prime mover can be made available on demand

Note B2 - See Engineering Recommendation G74, ETR 120 and IEC 60909 for guidance on fault current data. Additionally, fault current contribution data may be provided in the form of detailed graphs, waveforms and/or tables.

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---------------------------------- PART 2a ----------------------------------

Generation set model data: Synchronous generation sets (or equivalent synchronous generation sets)

Generation set identifier ____________________

Type of generation set (wound rotor, salient pole or asynchronous equivalent). See note C1 ____________________

____

____

Positive sequence (armature) resistance (HV connected generators only) ___________per unit

Inertia constant (generation set and prime mover). (HV connected generators only) ________MWsec/MVA

Direct axis resistances:

Sub-transient (X''_d) – unsaturated / saturated ___________per unit

Transient (X'_d) – unsaturated / saturated (HV connected generators only) ___________per unit

Synchronous (X_d) – unsaturated / saturated (HV connected generators only) ___________per unit

Time constants:

State whether time constants are open or short circuit (HV connected only) ____________________

D-axis sub-transient – unsaturated / saturated (HV connected generators only) ___________________s

D-axis transient – unsaturated / saturated (HV connected generators only) ___________________s

Note C1 – Asynchronous generators may be represented by an equivalent synchronous generator data set

---------------------------------- PART 2b ----------------------------------

Generation set model data: Fixed speed induction generation sets (see notes D1 and D2)

Magnetising reactance (HV connected generators only)	N/A______per unit
Stator resistance (HV connected generators only)	N/A _____per unit
Stator reactance (HV connected generators only)	N/A _____per unit
Inner cage or running rotor resistance (HV connected generators only)	N/A ______per unit
Outer cage or standstill rotor reactance (HV connected generators only)	N/A ______per unit
State whether data is inner-outer cage or running-standstill (HV generators connected only)	N/A____________
Total effective inertia constant (generator and prime mover). HV connected generators only	N/A ____MWsec/MVA
Shunt capacitance connected in parallel at % of rated output:	
Starting	0 kVAr
20%-100%	25 kVAr
40%	
60%	
80%	
100%	
Active power and reactive power import during start-up	16kVA @ 50% P.F, typically < 60 sec
Active power and reactive power import during switching operations e.g. '6 to 4 pole' change-over (HV connected generators only)	_N/A____MW-MVAr / time graphs
Under voltage protection setting & time delay	0.88pu, 2 s; 0.50pu, 0.1s
Slip at rated output (HV connected generators only)	_N/A_______%

Note D1 – Asynchronous generators may be represented by an equivalent synchronous data set

Note D2 – You will need to provide the above data for each asynchronous generation set based on the number of pole sets (i.e. two data sets for dual speed 4/6 pole machines) energynetworks association

-------------------------------- PART 2c --------------------------------

Generation set model data: Doubly fed induction generation sets

Generation set maximum fault current contribution data (see note E1)

Magnetising reactance (HV connected generators only)	________per unit
Stator resistance (HV connected generators only)	________per unit
Stator reactance (HV connected generators only)	________per unit
Running rotor resistance (HV connected generators only)	________per unit
Running rotor reactance (HV connected generators only)	________per unit
Standstill rotor resistance (HV connected generators only)	________per unit
Standstill rotor reactance (HV connected generators only)	________per unit
State whether data is inner-outer cage or running-standstill (HV generators connected only)	________
Generator rotor speed range – Minimum to rated speed (HV connected generators only)	________rpm
Total effective inertia constant at rated speed (generator and prime mover). HV connected generators only	________MWsec/MVA

Note E1 – Fault current contribution data should be provided in Part 1 of this application form

---------------------------------- PART 2d ----------------------------------

Generation set model data: Series converter / inverter connected generation sets

Generation set maximum fault current contribution data (see note E1)

Generator rotor speed range (HV connected generators only) _______________rpm

Total effective inertia constant (generator and prime mover). HV connected generators only _______MWsec/MVA

Note E1 – Fault current contribution data should be provided in Part 1 of this application form

------------------------------- PART 2e -------------------------------

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Transformer information

Transformer identifier ______________________

Transformer type (Unit/Station/Auxiliary) ______________________

Number of identical units ______________________

Type of cooling ______________________

Rated (apparent) power ______________________ MVA

Rated voltage ratio (on principal tap) ______________________ kV/kV

Positive sequence resistance (HV connected only) ______________________ per unit

Positive sequence reactance at principal tap ______________________ per unit

Winding configuration (e.g. Dyn11). HV connected only ______________________

Type of tap changer (on load / off circuit) ______________________

Tap step size ______________________ %

Maximum ratio tap ______________________ %

Minimum ratio tap ______________________ %

Method of voltage control (HV connected only) ______________________

Method of earthing of high-voltage winding ______________________

Method of earthing of low-voltage winding ______________________

Aeolus Power WIND ENERGY

Endurance wind power

Turbine

Configuration	3 blades, horizontal axis, downwind
Rated power @ 9.5 m/s	50kW
Applications	Direct grid-tie
Rotor speed	43 rpm
Cut-in wind speed	3.5 m/s (7.8 mph)
Cut-out wind speed	25 m/s (56 mph)
Survival wind speed	52 m/s (116 mph)
Overall weight	3 990 kg (8 800 lbs)

Rotor

Rotor diameter	19.2 m (63.0 ft)
Swept area	290 m² (3120 ft²)
Blade length	9.00 m (29.5 ft)
Blade material	Fiberglass/Polyester
Power regulation	Stall control (constant speed)

Generator

Type	Induction generator
Configurations	3ɸ, 400 VAC @ 50 Hz

Brake & Safety Systems

Main brake system	Rapid fail-safe dual mechanical brakes
Secondary safety	Pitch control system (for over-speed regulation) using passive, spring-loaded mechanism
Automatic shut down triggered by :	- High wind speed - Grid failure - Over-speed - All other fault conditions

Controls

Control System	Programmable logic controller (PLC)
User interface	Wireless or wired network software interface for remote monitoring and control

Warranty

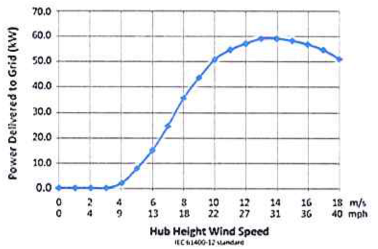
Turbine & controls	5 years parts and labour

Towers

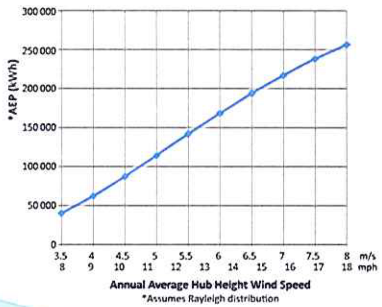
Types	Free-standing monopole: 24m (80ft) & 36.5 m (120ft)
Maintenance access	Safe climbing system Working space inside the nacelle tower-top work platform

¹Available tower sizes vary by region. Contact your local Wind Specialist for more details.

Power Curve



Annual Energy Production (AEP)



Annual Average Hub Height Wind Speed (m/s)	Annual Energy Production (kWh)
3.5	40 100
4.0	62 500
4.5	88 000
5.0	114 900
5.5	142 200
6.0	168 900
6.5	194 300
7.0	217 700
7.5	238 800
8.0	257 200

Wind Speed Conversion Table

m/s	4	5	6	7	8	9	10	11	12	14
km/h	14	18	22	25	29	32	36	40	43	50
mph	9	11	13	16	18	20	22	25	27	31

CE

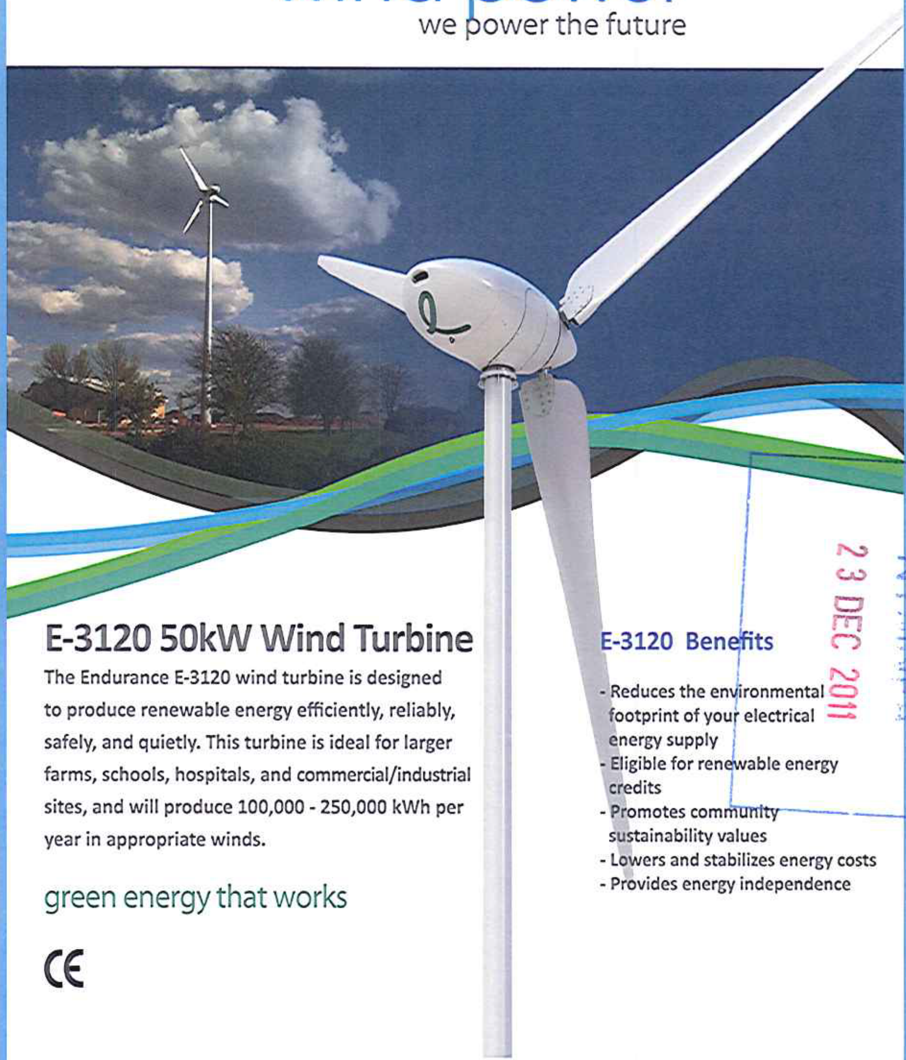
bullfrogpower

Endurance Wind Power uses 100% renewable energy at its head office and manufacturing plant

Aeolus Power WIND ENERGY

Endurance wind power

we power the future



E-3120 50kW Wind Turbine

The Endurance E-3120 wind turbine is designed to produce renewable energy efficiently, reliably, safely, and quietly. This turbine is ideal for larger farms, schools, hospitals, and commercial/industrial sites, and will produce 100,000 - 250,000 kWh per year in appropriate winds.

green energy that works

CE

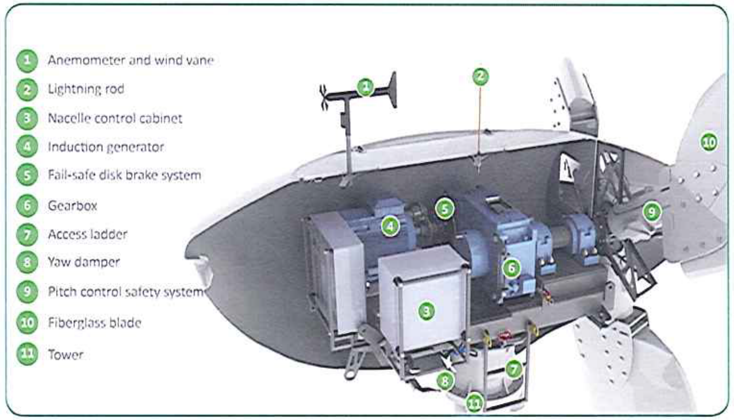
E-3120 Benefits

- Reduces the environmental footprint of your electrical energy supply
- Eligible for renewable energy credits
- Promotes community sustainability values
- Lowers and stabilizes energy costs
- Provides energy independence

web: www.aeoluspower.co.uk

Aeolus Power WIND ENERGY

E-3120 50kW Wind Turbine



1 Anemometer and wind vane
Measures wind speed and direction to control starting, stopping, and orientation of the turbine to maximize power production.

2 Lightning rod
Guides lightning to the ground, protecting the turbine.

3 Nacelle control cabinet
Houses the tower-top electronics in a weather-protected environment for maximum reliability. The main turbine control panel is located at the base of the tower for easy access.

4 Induction generator
Delivers grid-compatible power and eliminates the need for an inverter or other power electronics. This improves efficiency and reliability, and reduces up-front costs.

5 Fail-safe disk brake system
Safely stops the wind turbine using twin brake calipers in situations such as extreme wind or grid failure.

6 Gearbox
Drives the generator at full speed while the rotor turns slowly. The gearbox uses rugged, conventional design for long life and high reliability.

7 Access ladder
Allows easy and safe access to the nacelle for maintenance. Safety is a top design priority.

8 Yaw damper
While the turbine is aerodynamically oriented by the wind, the yaw damper smooths the movement to ease tower and rotor loads.

9 Pitch control safety system
Provides backup protection against rotor over speed. If the rotor turns too fast for any reason, the blades are pitched by a spring mechanism to control the speed.

10 Fiberglass blade
Designed to quietly and efficiently produce energy, particularly in light winds.

11 Tower
Attractive monopole towers are available in sizes from 24 metres (80ft) to 36.5 metres (120ft) to comply with height restrictions or to reach the best winds at your site.

Aeolus Power WIND ENERGY

Cornerstones of Endurance Design

Production Efficiency
Most distributed wind customers did not select their site for wind resources, but look to generate power from the wind available to them. Endurance wind turbines are designed specifically for less-than-perfect wind conditions.

Swept Area
The blades capture the energy of the wind. The larger the rotor diameter, the more wind energy the turbine captures. The Endurance E-3120 has a 19m (63 ft) rotor diameter- one of the largest rotor diameters per rated kW in its class- to capture the most wind energy.

Motoring
Motoring starts the blades spinning so the turbine operates in lighter wind conditions than if it relied solely on the wind to start (3-phase models only).

Generator Type
The induction generator produces electricity that can be transferred to the power grid without inverters. This provides lower equipment and maintenance costs and increases overall power production.

Reliability
All Endurance turbines have been extensively tested to ensure customers receive dependable energy production. They are built with proven commercial components for durability and easy support in the future.

Five Year Warranty
Endurance offers one of the best warranties in the wind industry, covering all defective components and labor for five years.

Safe Operation
When the turbine control system detects any fault, such as high wind or a grid power loss, the dual caliper disc brake system activates, safely stopping the turbine until the condition is cleared.

Passive Stall Rotor Design
The fixed-speed rotor aerodynamically stalls the blades as the first layer of protection for the turbine during high winds.

Control and Remote Interface Software
Each Endurance wind turbine is operated safely by an onboard computer system with advance control logic. This system also records data including energy production, average power, wind speed and event history. Turbine controls and data are also remotely available from a web browser.

Quiet Operation
Quiet operation is essential for a wind turbine in a community environment. Endurance turbines use slowly turning blades and high-quality manufactured components to make them the quietest turbines in their class.

Clean Aesthetics
A wind turbine makes a powerful statement about your commitment to the environment and clean energy. Endurance wind turbines have clean lines and make an attractive addition to any landscape.