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ROMNEY WIND ENERGY CENTRE

Specifications Report, Wind Facility (Not Class 2)

Romney Energy Centre Limited Partnership

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1 PREAMBLE

Romney Energy Centre Limited Partnership (the “Proponent”) is proposing to develop the Romney Wind Energy Centre (the “Project”) which is subject to Ontario Regulation (O. Reg.) 359/09 (Renewable Energy Approvals (REA) [1] under Part V.0.1 of the Ontario Environmental Protection Act (EPA)), as amended. EDF EN was awarded a contract for this Project in March 2016 from the Independent Electricity System Operator (IESO) under the Large Renewable Procurement (LRP), and is seeking a Renewable Energy Approval (REA) from the Ontario Ministry of the Environment and Climate Change (MOECC). The Project will be owned and operated by Romney Energy Centre Limited Partnership.

This Specifications Report, Wind Facility (Not Class2) (SR) has been prepared in accordance with Table 1 of O. Reg 359/09 and the Technical Guide to Renewable Energy Approvals, Chapter 9: Additional reports that may be required as part of an REA application, Section 13 Specifications Report Wind Facility (Not Class 2)[3]. Table 1-1 presents the corresponding sections for each SR requirement.

Table 1-1: Design and Operations Report Requirements and Corresponding Sections

Requirement	Section
Provide specifications of each wind turbine, including make, model, name plate capacity, hub height above grade, rotational speeds and acoustic emission data, including the sound power level and frequency spectrum, in terms of octave –band sound power levels.	2-3

2 TECHNICAL SPECIFICATIONS

The Project is considered to be a Class 4 Wind Facility. At the time of this report the final wind turbine technology has not been selected; however, it is likely to be a 3.0 to 3.6 MW turbine. For the purposes of reference, the Vestas V136-3.45 MW STE (serrated trailing edge) turbines will be considered, some of which may need to be de-rated to achieve a total installed capacity of no more than 60 MW. Up to 18 turbines will be installed; turbine rotors and nacelles will be mounted on towers of up to 132 m in height consisting of several steel sections. The maximum sound power level of the proposed turbines is 105.5 dBA. A summary of technical specifications is provided in Table 2-1.

Table 2-1: Summary of Turbine Technical Specifications

Model	**Vestas V-136 STE**
Design	Steel, tubular; up to 7 sections
Rated Power	3.45 MW
Hub height	132 m
Rotor diameter	136 m
Number of blades	3
Rotational Speed (rpm)	5.6-15.3
Cut-in wind speed	3 m/s
Cut-out wind speed	22.5 m/s
Nominal wind speed	11.5 m/s
Maximum sound power level	105.5 dBA

Additional technical information on Vestas V136-3.45 MW STE is presented in Appendix A.

3 ACOUSTIC EMISSIONS DATA

Broadband and third octave-band sound power levels for all relevant noise operation modes of the Vestas V136 -3.45 MW STE wind turbine were provided by the manufacturer as shown in Appendix A.

The octave band sound power levels used for the model in the Draft Noise Impact Assessment (NIA) [4] are those stated for each octave band centre frequency in Table 3-1 to Table 3-3.

Table 3-1: Vestas V136 STE Mode 0 wind turbine acoustic emission summary

Make and Model: Vestas V136										
Electrical Rating: 3.450MW										
Hub Height (m): 132										
Wind Shear Coefficient: 0.36, Worst case summer night time shear of the region										
	Octave band sound power level [dB]									
	Manufacturer's emission levels*					Adjusted emission levels				
Wind speed [m/s]	16	17	18	19	20	6	7	8	9	10
Frequency [Hz]										
31.5	123.4	124.1	124.8	125.5	126.1	126.1	126.1	126.1	126.1	126.1
63	117.8	118.4	118.9	119.2	119.6	119.6	119.6	119.6	119.6	119.6
125	113.9	114.0	114.1	114.1	114.2	114.2	114.2	114.2	114.2	114.2
250	103.8	103.8	103.7	103.5	103.4	103.4	103.4	103.4	103.4	103.4
500	101.7	101.6	101.5	101.3	101.2	101.2	101.2	101.2	101.2	101.2
1000	100.2	100.2	100.2	100.1	100.2	100.2	100.2	100.2	100.2	100.2
2000	96.1	96.1	96.2	96.1	96.1	96.1	96.1	96.1	96.1	96.1
4000	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8
8000	74.4	74.4	74.4	74.3	74.4	74.4	74.4	74.4	74.4	74.4
A-weighted	105.5	105.5	105.5	105.5	105.5	105.5	105.5	105.5	105.5	105.5

*Manufacturer's emission levels are referenced to hub height wind speeds and not 10m wind speeds.

Table 3-2: Vestas V136 STE Mode 1 wind turbine acoustic emission summary

Make and Model: Vestas V136										
Electrical Rating: 3.450MW										
Hub Height (m): 132										
Wind Shear Coefficient: 0.36, Worst case summer night time shear of the region										
	Octave band sound power level [dB]									
	Manufacturer's emission levels*					Adjusted emission levels				
Wind speed [m/s]	16	17	18	19	20	6	7	8	9	10
Frequency [Hz]										
31.5	122.3	123.0	123.7	124.4	125.0	125.0	125.0	125.0	125.0	125.0
63	116.7	117.3	117.8	118.1	118.5	118.5	118.5	118.5	118.5	118.5
125	112.8	112.9	113.0	113.0	113.1	113.1	113.1	113.1	113.1	113.1
250	102.7	102.7	102.6	102.4	102.3	102.3	102.3	102.3	102.3	102.3
500	100.6	100.5	100.4	100.2	100.1	100.1	100.1	100.1	100.1	100.1
1000	99.1	99.1	99.1	99.0	99.1	99.1	99.1	99.1	99.1	99.1
2000	95.0	95.0	95.1	95.0	95.0	95.0	95.0	95.0	95.0	95.0
4000	88.7	88.7	88.7	88.7	88.7	88.7	88.7	88.7	88.7	88.7
8000	73.3	73.3	73.3	73.2	73.3	73.3	73.3	73.3	73.3	73.3
A-weighted	104.4	104.4	104.4	104.4	104.4	104.4	104.4	104.4	104.4	104.4

*Manufacturer's emission levels are referenced to hub height wind speeds and not 10m wind speeds.

Table 3-3: Vestas V136 STE Mode 2 wind turbine acoustic emission summary

Make and Model: Vestas V136										
Electrical Rating: 3.45 MW										
Hub Height (m): 132										
Wind Shear Coefficient: 0.36, Worst case summer night time shear of the region										
	Octave band sound power level [dB]									
	Manufacturer's emission levels*					Adjusted emission levels				
Wind speed [m/s]	16	17	18	19	20	6	7	8	9	10
Frequency [Hz]										
31.5	121.5	122.2	122.8	123.5	124.1	124.1	124.1	124.1	124.1	124.1
63	115.9	116.5	116.9	117.2	117.6	117.6	117.6	117.6	117.6	117.6
125	111.9	112.1	112.1	112.1	112.2	112.2	112.2	112.2	112.2	112.2
250	101.9	101.8	101.7	101.5	101.4	101.4	101.4	101.4	101.4	101.4
500	99.7	99.6	99.5	99.3	99.2	99.2	99.2	99.2	99.2	99.2
1000	98.2	98.2	98.2	98.1	98.2	98.2	98.2	98.2	98.2	98.2
2000	94.2	94.2	94.2	94.1	94.1	94.1	94.1	94.1	94.1	94.1
4000	87.9	87.8	87.8	87.8	87.8	87.8	87.8	87.8	87.8	87.8
8000	72.5	72.4	72.4	72.3	72.4	72.4	72.4	72.4	72.4	72.4
A-weighted	103.5	103.5	103.5	103.5	103.5	103.5	103.5	103.5	103.5	103.5

*Manufacturer's emission levels are referenced to hub height wind speeds and not 10m wind speeds.

4 REFERENCES

[1] Ontario Regulation 359/09, made under the Environmental Protection Act, Renewable Energy Approvals under Part 1.0 of the Act.

[2] Ontario Regulation 521/10, made under the Environmental Protection Act, Renewable Energy Approvals under Part 1.0 of the Act.

[3] Technical Guide to Renewable Energy Approvals, Ontario Ministry of the Environment, 2013.

[4] DNV GL, Draft Noise Impact Assessment, Romney Wind Project, 18 January 2017.

[5] IEEE C57.12.90 – Distribution, Power, and Regulating Transformers. 2010

APPENDIX A – VESTAS V136-3.45 SPECIFICATIONS

Vestas®

3 MW PLATFORM

Wind. It means the world to us.™

Are you looking for the maximum return on **your investment** in wind energy?

Wind energy means the world to us. And we want it to mean the world to our customers, too, by maximising your profits and strengthening the certainty of your investment in wind power.

That's why, together with our partners, we always strive to deliver cost-effective wind technologies, high quality products and first class services throughout the entire value chain. And it's why we put so much emphasis on the reliability, consistency and predictability of our technology.

We have more than 35 years' experience in wind energy. During that time, we've delivered more than 77 GW of installed capacity in 75 countries. That is more than anyone else in the industry. We currently monitor over 33,000 wind turbines across the globe. All tangible proof that Vestas is the right partner to help you realise the full potential of your wind site.

What is the 3 MW Platform today?
The 3 MW platform was introduced in 2010 with the launch of the V112-3.0 MW®. Over 11 GW of the 3 MW platform has been installed all over the world onshore and offshore making it the obvious choice for customers looking for highly flexible and trustworthy turbines.

Since then the 3 MW platform was upgraded and new variants were introduced utilising untapped potential of the platform. All variants carry the same nacelle design and the hub design has been re-used to the largest extend possible. In addition, our engineers have increased the nominal power across the entire platform improving your energy production significantly.

With this expansion, the 3 MW platform covers all IEC wind classes with a variety of rotor sizes and a higher rated output power of 3.45 MW.

You can choose from the following turbines on the 3 MW platform:
- V105-3.45 MW™ – IEC IA
- V112-3.45 MW™ – IEC IA
- V117-3.45 MW™ – IEC IB/IEC IIA
- V126-3.45 MW™ – IEC IIB
- V126-3.45 MW™ – IEC IIA
- V136-3.45 MW™ – IEC IIB/IEC IIIA

All variants of the 3 MW platform are based on the proven technology of the V112-3.0 MW® with a full-scale converter, providing you with superior grid performance.

Our 3 MW platform is designed for a broad range of wind and site conditions, enabling you to mix turbines across your site or portfolio of sites, delivering industry-leading reliability, serviceability and exceptional energy capture optimising your business case.

All turbine variants are equipped with the same ergonomically designed and very spacious nacelle which makes it easier for maintenance crews to gain access, so they can reduce the time spent on service while maximizing the uptime without compromising safety. All turbines can be installed and maintained using standard installation and servicing tools and equipment further reducing the operation and maintenance costs by minimising your stock level of spare parts.

+58,000

The V112-3.45 MW® and the other 3 MW variants advance the already proven technology powering over 58,000 installed Vestas turbines worldwide - more than any other supplier.

How does our technology generate **more energy?**

More power for every wind site
V112-3.45 MW™, V117-3.45 MW™, V126-3.45 MW™ and V136-3.45 MW™ are available with several noise modes to meet sound level restrictions with an optimised production. The power system enables superior grid support and it is capable of maintaining production across severe drops in grid voltage, while simultaneously minimising tower and foundation loads. It also allows rapid down-rating of production to 10 per cent nominal power.

Proven technologies - from the company that invented them
The 3 MW platform is a low-risk choice. It is based on the proven technologies that underpin more than 58,000 Vestas turbines installed around the world. Using the best features from across the range, as well as some of the industry's most stringently tested components and systems, the platform's reliable design minimises downtime – helping to give you the best possible return on your investment.

With an operating range that covers all wind classes, our 3 MW platform delivers unrivalled energy production. The proven blade technology from the V112-3.0 MW® is used on the V105-3.45 MW™, the V112-3.45 MW™ and on the V117-3.45 MW™. The industry known structural shell blades are used on the V126-3.45 MW™ and V136-3.45 MW™- a technology which is also used on the 2 MW V110-2.0 MW™ variant.

Reliable and robust
The Vestas Test Centre is unrivalled in the wind industry. We test most nacelle components using Highly Accelerated Life Testing (HALT) to ensure reliability. For critical components, HALT identifies potential failure modes and mechanisms. Specialised test rigs ensure strength and robustness for the gearbox, generator, yaw and pitch system, lubrication system and accumulators. Our quality-control system ensures that each component is manufactured to design specifications and performs at site. We systematically monitor measurement trends that are critical to quality, locating defects before they occur.

The 3 MW platform covers all wind segments enabling you to find the best turbine for your specific site.

WINDCLASSES - IEC

TURBINE TYPE	IEC III (6.0 - 7.5 m/s)	IEC II (7.5 - 8.5 m/s)	IEC I (8.5 - 10.0 m/s)
3 MW TURBINES			
V105-3.45 MW™ IEC IA			■
V112-3.45 MW™ IEC IA			■
V117-3.45 MW™ IEC IB/IEC IIA		■	■
V126-3.45 MW™ IEC IIA		■	■
V126-3.45 MW™ IEC IIB	■	■	
V136-3.45 MW™ IEC IIB/ IEC IIIA	■	■	

■ Standard IEC conditions ■ Site dependent

Options available for the 3 MW platform

An option is an extra feature that can be added to the turbine to suit a project's specific needs. By adding options to the standard turbine, we can enhance the performance and adaptability of the wind power project and facilitate a shorter permitting cycle at restricted sites. The options can even be a decisive factor in realising your specific project, and the business case certainty of the investment.

Here is a list of the options available for the 3 MW platform:

- High Wind Operation
- Power Optimised Mode
- Condition Monitoring System
- Service Personnel Lift
- Vestas Ice Detection
- Vestas De-Icing
- Low Temperature Operation to - 30°C
- Fire Suppression
- Shadow detection
- Increased Cut-In
- Nacelle Hatch for Air Inlet
- Aviation Lights
- Aviation Markings on the Blades
- Obstacle Collision Avoidance System (OCAS™)

Life testing

The Vestas Test Centre has the unique ability to test complete nacelles using technologies like Highly Accelerated Life Testing (HALT). This rigorous testing of new components ensures the reliability of the 3 MW platform.

Is the 3 MW platform the optimal choice for **your specific site?**

One common nacelle – five different rotor sizes
The wind conditions on a wind project site are often not identical. The 3 MW platform features a range of turbines that cover all wind classes and combined across your site they can maximise the energy output of your wind power plant.

Tip-height restrictions and strict grid requirements
With a rotor size of 105 m, the V105-3.45 MW™ IEC IA is the turbine that fits the most severe wind conditions. It has an extremely robust design for tough site conditions and is especially suited for markets with tip-height restrictions and high grid requirements.

Like all the other 3 MW turbines, the V105-3.45 MW™ is equipped with a full-scale converter ensuring full compliance with the challenging grid codes in countries like the UK and Ireland.

Cold climates
The V112-3.45 MW™, V117-3.45 MW™ , V126-3.45MW™ and V136-3.45 MW™ can be combined with Vestas De-Icing and Vestas Ice Detection ensuring optimum production in cold climates.

The Vestas De-Icing System is fully SCADA integrated and can be triggered automatically or manually depending on your de-icing strategy. Automatic control protects your investment, optimising the trigger point so the turbine only stops to de-ice when there is an expected net power production gain.

High- and medium-wind sites
The V112-3.45 MW™ IEC IA is a high-wind turbine and has a very high capacity factor. Similar to the other 3 MW turbines, the V112-3.45 MW™ IEC IA turbine makes efficient use of its grid compatibility and is an optimal choice for sites with MW constraints.

On medium wind-sites the V117-3.45 MW™ IEC IB/IEC IIA, V126-3.45 MW™ IEC IIA, V126-3.45 MW™ IEC IIB, and V136-3.45 MW™ IEC IIB/ IEC IIIA are excellent turbine choices. A combination of the variants can optimise your site layout and improve your production significantly on complex sites.

Low-wind sites
Built on the same proven technology as the V112-3.0 MW®, the V136-3.45 MW™ IEC IIB/ IEC IIIA is our best performer on low-wind sites. The larger rotor enable greater wind capture, which in turn produces more energy to reduce levelised cost of energy (LCOE). The result is exceptional profitability in areas with low wind, and new frontiers for wind energy investment.

Large Diameter Steel Towers (LDST) support the added rotor size and rating of Vestas turbines to increase Annual Energy Production on low-wind sites.

LDST is specially designed with a larger diameter in the bottom section that allows for optimal strength at high hub heights.

Maximising old permits
Although the V136-3.45 MW™ is one of the highest producing low wind turbine available, some old permits may simply be too tight to accept it. Although the V117-3.45 MW™ and V126-3.45 MW™ are medium-wind turbines, they still deliver an excellent business case on low-wind sites.

Due to the similar electrical properties and nacelle design, it is easy to mix and match the turbines from the 3 MW platform to maximise production on heavily constrained sites.

Would you **benefit** from uninterrupted control of wind energy production?

Knowledge about wind project planning is key
Getting your wind energy project up and operating as quickly as possible is fundamental to its long-term success. One of the first and most important steps is to identify the most suitable location for your wind power plant. Vestas' SiteHunt® is an advanced analytical tool that examines a broad spectrum of wind and weather data to evaluate potential sites and establish which of them can provide optimum conditions for your project.

In addition, SiteDesign® optimises the layout of your wind power plant. SiteDesign® runs Computational Fluid Dynamics (CFD) software on our powerful in-house supercomputer Firestorm to perform simulations of the conditions on site and analyse their effects over the whole operating life of the plant. Put simply, it finds the optimal balance between the estimated ratio of annual revenue to operating costs over the lifetime of your plant, to determine your project's true potential and provide a firm basis for your investment decision.

The complexity and specific requirements of grid connections vary considerably across the globe, making the optimal design of electrical components for your wind power plant essential. By identifying grid codes early in the project phase and simulating extreme operating conditions, Electrical PreDesign provides you with an ideal way to build a grid compliant, productive and highly profitable wind power plant. It allows customised collector network cabling, substation protection and reactive power compensation, which boost the cost efficiency of your business.

Advanced monitoring and real-time plant control
All our wind turbines can benefit from VestasOnline® Business, the latest Supervisory Control and Data Acquisition (SCADA) system for modern wind power plants.

This flexible system includes an extensive range of monitoring and management functions to control your wind power plant. VestasOnline® Business enables you to optimise production levels,

+33,000

The Vestas Performance and Diagnostics Centre monitors more than 33,000 turbines worldwide. We use this information to continually develop and improve our products and services.

monitor performance and produce detailed, tailored reports from anywhere in the world. The VestasOnline® Power Plant Controller offers scalability and fast, reliable real-time control and features customisable configuration, allowing you to implement any control concept needed to meet local grid requirements.

Surveillance, maintenance and service

Operating a large wind power plant calls for efficient management strategies to ensure uninterrupted power production and to control operational expenses. We offer 24/7 monitoring, performance reporting and predictive maintenance systems to improve turbine performance and availability. Predicting faults in advance is essential, helping to avoid costly emergency repairs and unscheduled interruptions to energy production.

Our Condition Monitoring System (CMS) assesses the status of the turbines by analysing vibration signals. For example, by measuring the vibration of the drive train, it can detect faults at an early stage and monitor any damage. This information allows pre-emptive maintenance to be carried out before the component fails, reducing repair costs and production loss.

Additionally, our Active Output Management® (AOM) concept provides detailed plans and long term agreements for service and maintenance, online monitoring, optimisation and troubleshooting. It is possible to get a full scope contract, combining your turbines' state-of-the-art technology with guaranteed time or energy-based availability performance targets, thereby creating a solid base for your power plant investment. The Active Output Management® agreement provides you with long term and financial operational peace of mind for your business case.

V105-3.45 MW™ IEC IA

Facts & figures

POWER REGULATION	Pitch regulated with variable speed

OPERATING DATA

Rated power	3,450 kW
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Re cut-in wind speed	23 m/s
Wind class	IEC IA

Standard operating temperature range from -20°C* to +45°C with de-rating above 30°C

*subject to different temperature options

SOUND POWER

(Noise modes dependent on site and country)

ROTOR

Rotor diameter	105 m
Swept area	8,659 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub height	72.5 m (IEC IA)

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.9 m
Length	12.8 m
Width	4.2 m

HUB DIMENSIONS

Max. transport height	3.8 m
Max. transport width	3.8 m
Max. transport length	5.5 m

BLADE DIMENSIONS

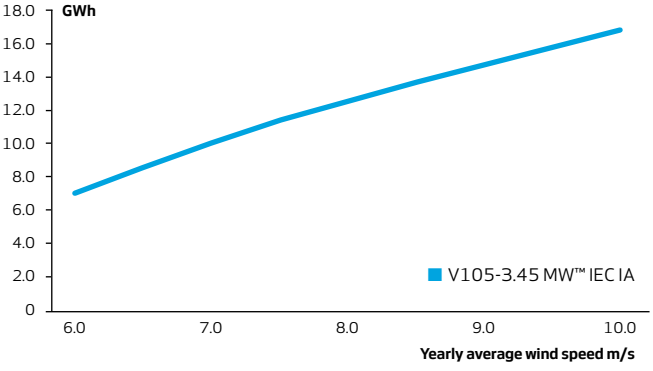
Length	51.2 m
Max. chord	4 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- High Wind Operation
- Power Optimised Mode
- Condition Monitoring System
- Service Personnel Lift
- Vestas Ice Detection
- Low Temperature Operation to -30°C
- Fire Suppression
- Shadow Detection
- Increased Cut-In
- Nacelle Hatch for Air Inlet
- Aviation Lights
- Aviation Markings on the Blades
- Obstacle Collision Avoidance System (OCAS™)

ANNUAL ENERGY PRODUCTION



Assumptions
One wind turbine, 100% availability, 0% losses, k factor =2, Standard air density = 1.225, wind speed at hub height

V112-3.45 MW™ IEC IA

Facts & figures

POWER REGULATION	Pitch regulated with variable speed

OPERATING DATA

Rated power	3,450 kW
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Re cut-in wind speed	23 m/s
Wind class	IEC IA

Standard operating temperature range from -20°C* to +45°C with de-rating above 30°C

*subject to different temperature options

SOUND POWER

(Noise modes dependent on site and country)

ROTOR

Rotor diameter	112 m
Swept area	9,852 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub height	69 m (IEC IA) and 94 m (IEC IA)

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.9 m
Length	12.8 m
Width	4.2 m

HUB DIMENSIONS

Max. transport height	3.8 m
Max. transport width	3.8 m
Max. transport length	5.5 m

BLADE DIMENSIONS

Length	54.7 m
Max. chord	4 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- High Wind Operation
- Power Optimised Mode
- Condition Monitoring System
- Service Personnel Lift
- Vestas Ice Detection
- Vestas De-Icing
- Low Temperature Operation to - 30°C
- Fire Suppression
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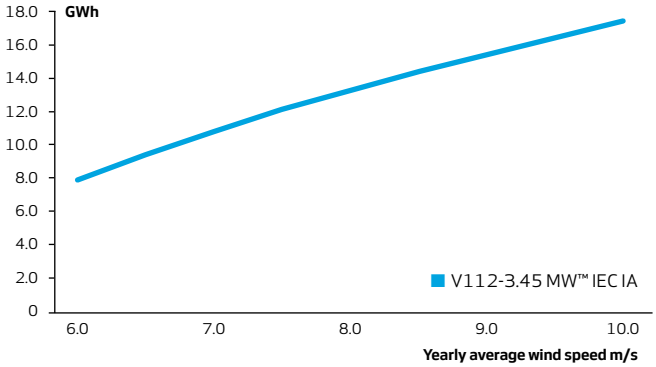
- Obstacle Collision Avoidance System (OCAS™)

ANNUAL ENERGY PRODUCTION



Assumptions
One wind turbine, 100% availability, 0% losses, k factor =2, Standard air density = 1.225, wind speed at hub height

V117-3.45 MW™ IEC IB/IEC IIA

Facts & figures

POWER REGULATION	Pitch regulated with variable speed

OPERATING DATA

Rated power	3,450 kW
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Re cut-in wind speed	23 m/s
Wind class	IEC IB/IEC IIA

Standard operating temperature range from -20°C* to +45°C with de-rating above 30°C

*subject to different temperature options

SOUND POWER

(Noise modes dependent on site and country)

ROTOR

Rotor diameter	117 m
Swept area	10,751 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub heights	80 m (IEC IB), 91.5 m (IEC IB) and 116.5 m (IEC IB/IEC IIA/DIBtS)

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.9 m
Length	12.8 m
Width	4.2 m

HUB DIMENSIONS

Max. transport height	3.8 m
Max. transport width	3.8 m
Max. transport length	5.5 m

BLADE DIMENSIONS

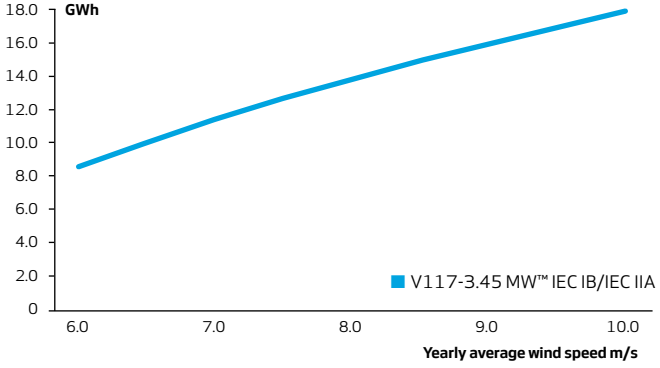
Length	57.2 m
Max. chord	4 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- High Wind Operation
- Power Optimised Mode
- Condition Monitoring System
- Service Personnel Lift
- Vestas Ice Detection
- Vestas De-Icing
- Low Temperature Operation to - 30°C
- Fire Suppression
- Shadow detection
- Increased Cut-In
- Nacelle Hatch for Air Inlet
- Aviation Lights
- Aviation Markings on the Blades
- Obstacle Collision Avoidance System (OCAS™)

ANNUAL ENERGY PRODUCTION



Assumptions
One wind turbine, 100% availability, 0% losses, k factor =2, Standard air density = 1.225, wind speed at hub height

V126-3.45 MW™ IEC IIB

Facts & figures

POWER REGULATION	Pitch regulated with variable speed

OPERATING DATA

Rated power	3,450 kW
Cut-in wind speed	3 m/s
Cut-out wind speed	22.5 m/s
Re cut-in wind speed	20 m/s
Wind class	IEC IIB

Standard operating temperature range from -20°C* to +45°C with de-rating above 30°C

*subject to different temperature options

SOUND POWER

(Noise modes dependent on site and country)

ROTOR

Rotor diameter	126 m
Swept area	12,469 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub heights	87 m (IEC IIB), 117 m (IEC IIB) and 137 m (IEC IIIA)

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.9 m
Length	12.8 m
Width	4.2 m

HUB DIMENSIONS

Max. transport height	3.8 m
Max. transport width	3.8 m
Max. transport length	5.5 m

BLADE DIMENSIONS

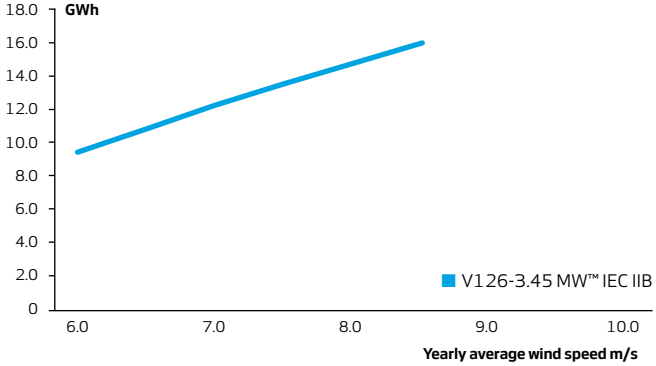
Length	61.7 m
Max. chord	4 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- High Wind Operation
- Power Optimised Mode
- Condition Monitoring System
- Service Personnel Lift
- Vestas Ice Detection
- Vestas De-Icing
- Low Temperature Operation to - 30°C
- Fire Suppression
- Shadow detection
- Increased Cut-In
- Nacelle Hatch for Air Inlet
- Aviation Lights
- Aviation Markings on the Blades
- Obstacle Collision Avoidance System (OCAS™)

ANNUAL ENERGY PRODUCTION



Assumptions
One wind turbine, 100% availability, 0% losses, k factor = 2, Standard air density = 1.225, wind speed at hub height

V126-3.45 MW™ IEC IIA

Facts & figures

POWER REGULATION	Pitch regulated with variable speed

OPERATING DATA

Rated power	3,450 kW
Cut-in wind speed	3 m/s
Cut-out wind speed	22.5 m/s
Re cut-in wind speed	20 m/s
Wind class	IEC IIA

Standard operating temperature range from -20°C* to +45°C with de-rating above 30°C

*subject to different temperature options

SOUND POWER

(Noise modes dependent on site and country)

ROTOR

Rotor diameter	126 m
Swept area	12,469 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub heights	87 m (IEC IIA), 117 m (IEC IIA/DIBtS), 137 m (IEC IIIA/DIBtS), 147 m (IEC IIIA), 149 m (DIBtS) and 166 m (DIBtS)

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.9 m
Length	12.8 m
Width	4.2 m

HUB DIMENSIONS

Max. transport height	3.8 m
Max. transport width	3.8 m
Max. transport length	5.5 m

BLADE DIMENSIONS

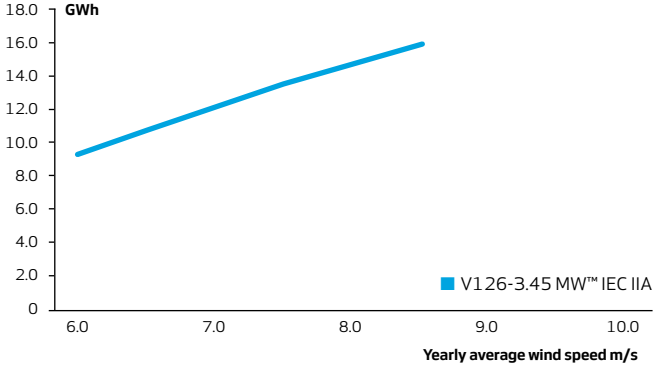
Length	61.7 m
Max. chord	4 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- High Wind Operation
- Power Optimised Mode
- Condition Monitoring System
- Service Personnel Lift
- Vestas Ice Detection
- Vestas De-Icing
- Low Temperature Operation to - 30°C
- Fire Suppression
- Shadow detection
- Increased Cut-In
- Nacelle Hatch for Air Inlet
- Aviation Lights
- Aviation Markings on the Blades
- Obstacle Collision Avoidance System (OCAS™)

ANNUAL ENERGY PRODUCTION



Assumptions
One wind turbine, 100% availability, 0% losses, k factor =2,
Standard air density = 1.225, wind speed at hub height

V136-3.45 MW™ IEC IIB/IEC IIIA

Facts & figures

POWER REGULATION — Pitch regulated with variable speed

OPERATING DATA

Rated power	3,450 kW
Cut-in wind speed	3 m/s
Cut-out wind speed	22.5 m/s
Re cut-in wind speed	20 m/s
Wind class	IEC IIB/IEC IIIA

Standard operating temperature range from -20°C* to +45°C with de-rating above 30°C

*subject to different temperature options

SOUND POWER

(Noise modes dependent on site and country)

ROTOR

Rotor diameter	136 m
Swept area	14,527 m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60 Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub heights 82 m (IEC IIB/IEC IIIA), 105 m (IEC IIIA), 112 m (IEC IIB/IEC IIIA), 132 m (IEC IIB/IEC IIIA/ DIBt2), 142 m (IEC IIIA), 149 m (DIBtS), and 166 m (DIBtS)

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.9 m
Length	12.8 m
Width	4.2 m

HUB DIMENSIONS

Max. transport height	3.8 m
Max. transport width	3.8 m
Max. transport length	5.5 m

BLADE DIMENSIONS

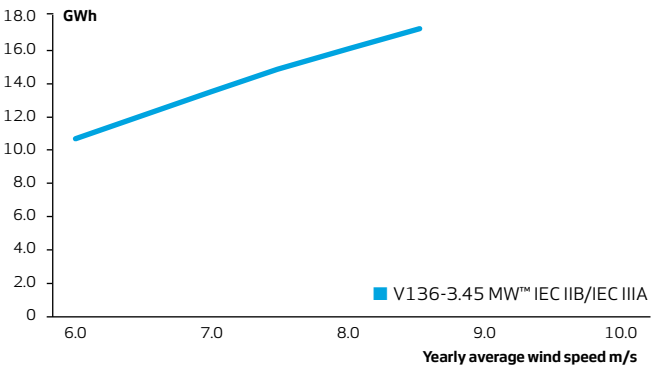
Length	66.7 m
Max. chord	4.1 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- High Wind Operation
- Power Optimised Mode
- Condition Monitoring System
- Service Personnel Lift
- Vestas Ice Detection
- Vestas De-Icing
- Low Temperature Operation to - 30°C
- Fire Suppression
- Shadow detection
- Increased Cut-In
- Nacelle Hatch for Air Inlet
- Aviation Lights
- Aviation Markings on the Blades
- Obstacle Collision Avoidance System (OCAS™)

ANNUAL ENERGY PRODUCTION



Assumptions
One wind turbine, 100% availability, 0% losses, k factor =2, Standard air density = 1.225, wind speed at hub height

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