Henvey Inlet Wind LP

Henvey Inlet Wind

Henvey Inlet Wind Energy Centre

Wind Turbine Specifications Report

Final

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Henvey Inlet Wind Energy Centre (HIWEC) - Wind Turbine Specifications Report – Final

Prepared by:

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Project Number:

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Date:

January, 2016

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AECOM: 2012-01-06

AECOM Signatures

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List of Acronyms and Glossary

AECOM......................AECOM Canada Ltd.
dB...............................Decibel
EA ....Environmental Assessment
FIT..............................Feed-in-Tariff
GBBR..........................Georgian Bay Biosphere Reserve
ha ....Hectare
HIFN...........................Henvey Inlet First Nation
HIFN EA Guidance Henvey Inlet First Nation Environmental Assessment Guidance Instrument
HIFN I.R. #2 ....Henvey Inlet First Nation Reserve No. 2
HIW ....Henvey Inlet Wind
HIWEC ....Henvey Inlet Wind Energy Centre
km ....Kilometre
kV...............................Kilovolt
LPS ....Lightning Protection System
m ....Metre
m^2...............................Metre squared
m/s ....Metre per second
Met tower ....Meteorological tower
MW.............................Megawatt
Nigig ....Nigig Power Corporation
O&M ....Operations and maintenance
OPA............................Ontario Power Authority
TS...............................Transformer station
UNESCO....................United Nations Educational, Scientific, and Cultural Organization
WTG...........................Wind Turbine Generator

1. Introduction and Overview

Nigig Power Corporation (Nigig) received a Feed-in-Tariff (FIT) Contract from the Ontario Power Authority (OPA) in 2011 for a 300 megawatt (MW) wind energy generation centre. Henvey Inlet Wind LP (HIW), a limited partnership between Pattern Renewable Holdings Canada ULC and Nigig, is proposing to develop the Henvey Inlet Wind Energy Centre (HIWEC), a 300 MW facility on Henvey Inlet First Nation Reserve No. 2 (HIFN I.R. #2). AECOM Canada Ltd. (AECOM) was retained by HIW to prepare an Environmental Assessment (EA) for the proposed HIWEC. The EA was conducted in accordance with the Henvey Inlet First Nation Environmental Assessment Guidance Instrument (HIFN EA Guidance) requirements.

1.1 Summary of Wind Turbine Specifications Report Requirements

The requirements for the Wind Turbine Specifications Report defined under the HIFN EA Guidance document are outlined in **Table 1-1** along with where information about those requirements can be found in this report.

Table 1-1: Adherence to Wind Turbine Specification Report Requirements under HIFN EA Guidance Document

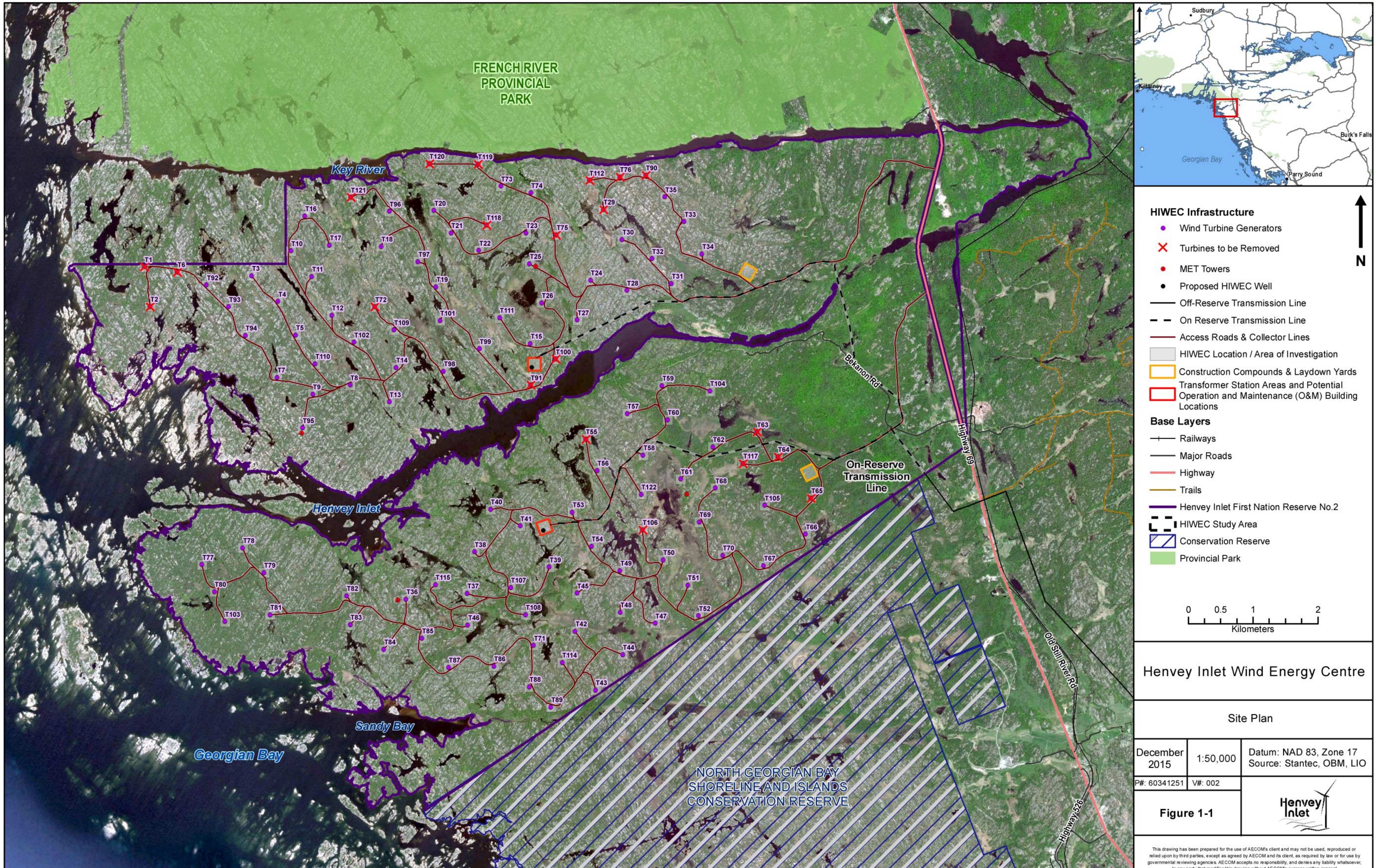
Requirement	Completed	Corresponding Section
The make, model, nameplate capacity, hub height above grade, and rotational speeds.	Yes	**Section 2.2** (**Table 2-1**)
The acoustic emissions data, determined and reported in accordance with standard CAN/CSA-C61400-11-07, “Wind Turbine Generator Systems – Part II: Acoustic Noise Measurement Techniques”, dated October 2007, including the overall sound power level, measurement uncertainty value, octave-band sound power levels (linear weighted), and tonality and tonal audibility.	Yes	Refer to the Noise Impact Assessment included as **Appendix M** of **Volume A**

1.2 Location and Study Area

The HIWEC study area includes the entirety of HIFN I.R. #2 plus a 550 metres (m) buffer extending beyond the HIFN I.R. #2 boundary. HIFN I.R. #2 is bounded on the north by the Key River, Georgian Bay to the west, Highway 69 to the east with some HIFN I.R. #2 property located on the east side of Highway 69. The southern boundary runs from Sandy Bay on the southwest corner in a north easterly direction to Highway 69 south of Bekanon Road. The geographic location is along the eastern shore of Georgian Bay, south of French River Provincial Park and directly north of North Georgian Bay Shoreline and Islands Conservation Reserve (**Figure 1-1**). HIFN I.R. #2 is part of the Georgian Bay Biosphere Reserve (GBBR) which encompasses 347,000 hectares (ha) of land stretching 300 kilometres (km) from Port Severn to the French River and is designated as a United Nations Educational, Scientific, and Cultural Organization (UNESCO) Biosphere Reserve (GBBR, 2015). Highway 69 is a major north-south highway connecting Highway 400 north of Parry Sound with the City of Greater Sudbury at Highway 17.

Generally, the HIWEC study area has shallow soils, with many rocky outcrops forming longitudinal ridges running on a northwest to southeast axis, and is divided roughly in half by the Henvey Inlet waterbody. Numerous wetland pockets are located between the ridges and across the study area, with upland regions supporting forested areas of poplar and jack pine. **Section 4** of the Description Report (**Appendix A** of **Volume A**) provides a more detailed description of the existing environmental conditions within the study area. The study area for the HIWEC also includes lands off-Reserve that are within the area that may experience increased noise levels from the HIWEC. All HIWEC components will be located within the HIWEC study area as shown in the site plan provided as **Figure 1-1**.

Figure 1-1: Site Plan



1.3 Proponent Contact and Key Information

The following table provides key HIWEC information.

Table 1-2: Key Information

Proponent:	The HIWEC is being developed by HIW. HIW is a limited partnership between Nigig Power Corporation, a company wholly owned by HIFN, and Pattern Renewable Holdings Canada ULC.	
HIWEC Location:	HIFN I.R. #2	
Energy Source:	Wind energy. No supplementary fuel sources will be used to generate electricity.	
Contracted Nameplate Capacity:	300 MW	
Website:	www.henveyinletwind.com	
Email:	info@henveyinletwind.com	
Telephone:	(705) 857-5265	
Proponent Contact Information:	**Ken Noble** President Nigig Power Corporation a company wholly owned by HIFN 295 Pickerel River Road Pickerel, ON P0G 1J0	**Kim Sachtleben** Project Director Pattern Renewable Holdings Canada ULC 355 Adelaide Street West Suite 100 Toronto, ON M5V 1S2
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2. Technical Specifications

2.1 Description of the Energy Source, Nameplate Capacity and Class of the Facility

The HIWEC will use wind to generate electricity through the use of commercial wind turbine generator (WTG) technology. The proposed WTG technology for the HIWEC is expected to be a Vestas V126-3.3 MW turbine. With a total nameplate capacity of 300 MW, the HIWEC is categorized as a Class 4 wind facility.

One hundred and twenty (120) WTGs are currently being assessed for the HIWEC with up to 91 WTGs to be constructed. To date, 21 of the 120 WTG locations have been identified for removal based on technical and environmental studies completed and comments received from HIFN members and the public.

2.2 Summary of Key Henvey Inlet Wind Energy Centre Information and Wind Turbine Generator Specifications

A summary of key HIWEC information is presented in the table below.

Table 2-1: Summary of Key Information[1]

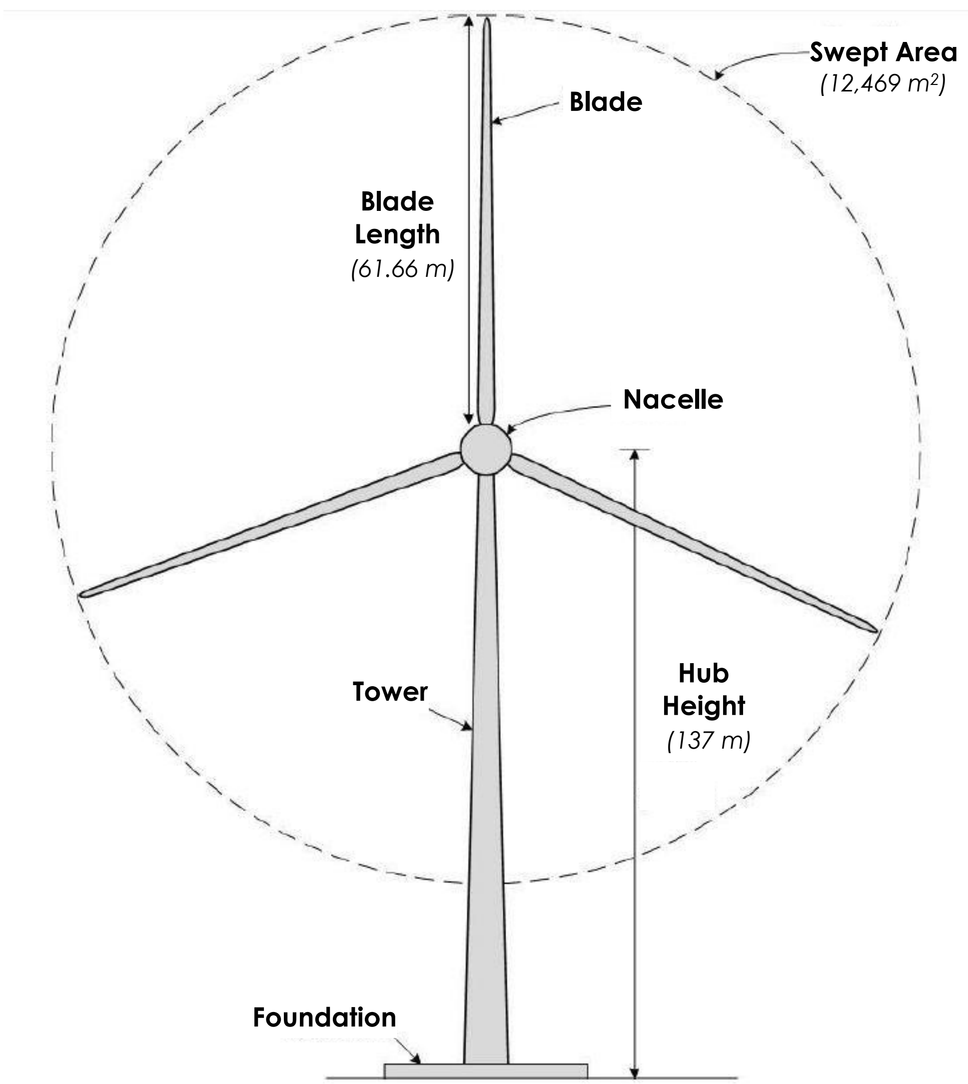
General Information	*Name:*	Henvey Inlet Wind Energy Centre (HIWEC)
	Ownership and Operation:	Henvey Inlet Wind LP (HIW)
	Lifespan (commercial operation):	30+ Years
	Nameplate Capacity:	300 MW
HIWEC study area *(as shown in **Figure 1-1**)*	*Location of HIWEC:*	Federal Crown land on HIFN I.R. #2
	Total HIWEC Study Area:	12,278 ha
	Total Area of permanent HIWEC footprint:	Approximately 173.1 ha
WTGs	*Make and Model:*	Vestas V126-3.3 MW
	Approximate Number Constructed:	Up to 91 WTGs
	Nominal WTG Power:	3.3 MW
	Number of Blades:	3
	Blade Length:	61.66 m
	Hub Height:	Up to 137 m
	Rotor Diameter:	126 m
	Cut-in Wind Speed:	3 metres per second (m/s)
	Cut-out Wind Speed:	22.5 m/s
	Rated Wind Speed:	12 m/s
	Swept Area:	12,469 metres squared (m^2)
	Foundation Dimensions:	0.08 ha x 2.5 m deep
Access Roads	*Access Roads: (includes shoulder, travel width and ditch)*	94.6 km x 15 m
Collector Lines	*34.5 kilovolts (kV) Collector Lines:* *(total combined length of proposed underground and/or overhead)*	94.6 km (within access road width)
On-Reserve Transmission Line	*230 kV on-Reserve Transmission Line:*	14.25 km x 15 m
Other HIWEC Structures and Facilities	*Transformer Stations (TSs):*	0.25 ha x 2
	Operations and Maintenance (O&M) Building:	2.8 ha
	Meteorological (Met) Towers:	4 (constructed)
Temporary Land Use *(Construction Phase)*	*Construction Compounds and Laydown Yards:*	4 to 6 ha x 2
	Wind Turbine Generator Staging Area (each WTG):	0.6 ha
	Crane Pads (at each WTG):	0.08 ha

1. *Dimensions are near approximations.*

2.2.1 Wind Turbine Generator Components

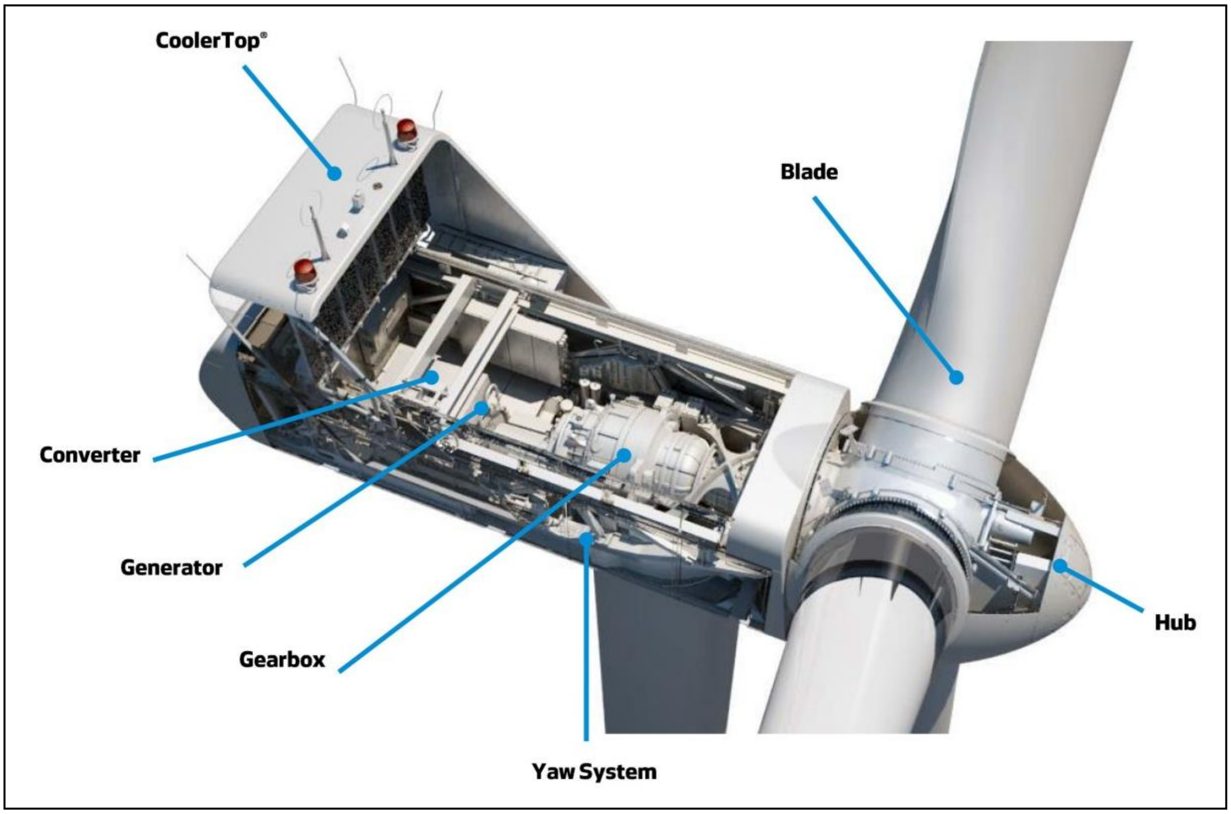
As shown on **Figure 2-1**, the Vestas V126-3.3 MW WTG is made up of four (4) main components: the foundation, tower, nacelle (e.g., hub) and blades. The nacelle will be mounted on a tubular steel tower which will be a maximum height of 137 m and contain internal personnel hoists and lifts for maintenance access. A prefabricated power module is located at the bottom of the tower and provides the platform for the power converter. The WTG pad-mounted transformer will be located beside the tower base. The WTG will be constructed on a foundation that is approximately 0.04 ha. The foundation consists of poured concrete and steel rebar to provide added strength.

Figure 2-1: Basic Wind Turbine Generator Specifications



The three (3) 61.66 m blades of the Vestas V126-3.3 MW WTG will generate electricity between the wind speeds of 3 m/s (i.e., the cut-in wind speed) and 22.5 m/s (i.e., the cut-out wind speed) and will reach its nameplate capacity of 3.3 MW when wind speeds reach approximately 11 to 12 m/s (Vestas, 2015a). As shown on **Figure 2-2**, most of the equipment used to convert wind energy into electricity is contained in the nacelle of the WTG. The nacelle also acts as a sound enclosure to reduce noise emissions.

Figure 2-2: Nacelle Arrangement



The Vestas V126-3.3 MW WTG is a pitch regulated upwind turbine with active yaw and a three-blade rotor. The WTG is able to operate the rotor at variable speed while maintaining the power output at or near rated power due to the WTG using OptiTip® concept and a power system based on an induction generator and full-scale converter (Vestas, 2015b). Based on the prevailing wind conditions, the blades of the WTG are continuously positioned to optimise pitch angle (Vestas, 2015b).

The nacelle includes major WTG components such as the main shaft and bearing, gearbox, brake disc and generator. The nacelle is climate controlled and is constructed from steel and fibreglass to protect against the elements. The WTG is equipped with lightning protection to protect from the effects of direct and nearby strikes. The Lightning Protection System (LPS) helps protect the WTG against physical damage caused by lightning strikes. The LPS consists of five (5) main parts:

- Lighting receptors;
- Down conducting system (a system to conduct the lightning current down the WTG to avoid or minimize damage to the LPS itself or other parts of the WTG);
- Protection against overvoltage and overcurrent;
- Shielding against magnetic and electrical fields; and
- Earthing system.

The LPS is designed according to the international standard IEC 61400-24:2010 Lightning Protection Level I (Vestas, 2013).

Refer to **Attachment A** for more information on the WTG technical specifications.

3. Acoustic Emissions Data

The Vestas V126-3.3 MW WTG with serrated trailing edges has a maximum broadband sound power level of 106 decibels (dB). Please refer to **Attachment B** for acoustic information, including the octave band performance.

4. References

Georgian Bay Biosphere Reserve, 2015:
Our Biosphere. Available: http://www.gbbr.ca/about-us/gbbr/. Accessed February 19, 2015.

Vestas Wind Systems A/S (Vestas), 2013:
Lightning Protection and EMC: V112-3.0 MW, V112-3.3 MW Mk 2, V117-3.3 MW Mk 2, V126-3.3 MW Mk 2. Document no.: 0010-6426 V05. Vestas: Denmark.

Vestas Wind Systems A/S (Vestas), 2015a:
3 MW Platform – Product Brochure. Vestas: Denmark.

Vestas Wind Systems A/S (Vestas), 2015b:
General Specification V126-3.3./3.45 MW 50/60 Hz. Document no.: 0034-7616 V11. Vestas: Denmark.

Attachment A

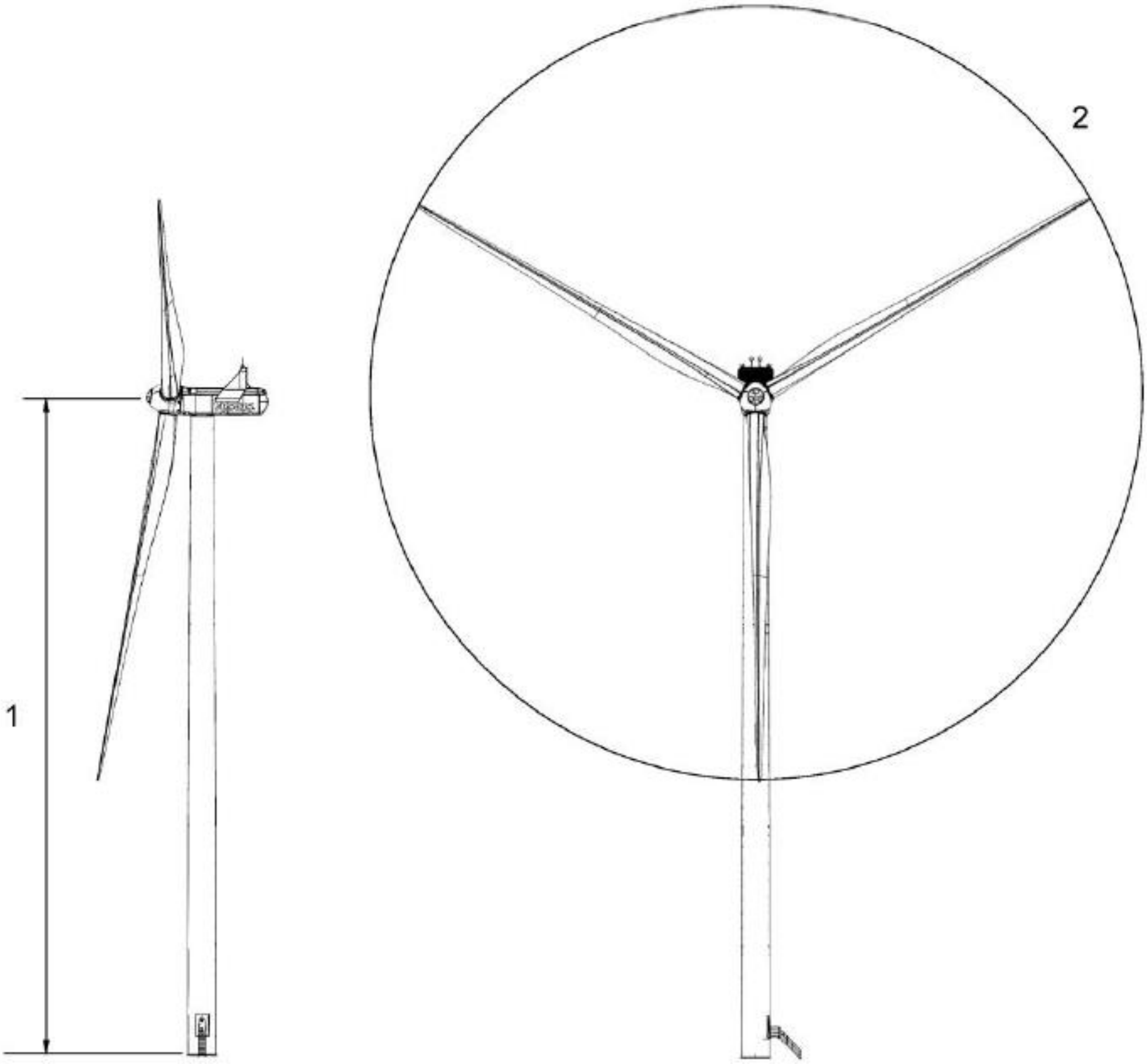
Vestas Technical Specifications V126-3.3/3.45 MW 50/60 Hz

TECHNICAL SPECIFICATIONS
V126-3.3/3.45 MW 50/60 Hz

Vestas Americas
Proprietary Information

1417 NE Everett Street, Portland, OR 97209, USA
Tel: +1 503 327 2000, vestas-americas@vestas.com, www.vestas.com
Company Reg. Name: Vestas - American Wind Technology, Inc., Communication name: Vestas Americas

1. DIMENSIONS



1 Hub Height: 87 m / 117 m / 137 m   2 Diameter: 126 m

2. GENERAL DATA

POWER REGULATION	Pitch regulated with variable speed

OPERATING DATA

Rated power	3,300 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 IIIA;DIBt2/IEC S

Standard operating temperature range from -20°C* to +45°C with de-rating above 30°C (20°C for 3.45 MW variant)

*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	117 m (IEC IIIB), 137 m LDST (IEC IIIA/DIBt2), 147 m (IEC IIIA/DIBt2) and 149 m (DIBtS)

NACELLE DIMENSIONS

Height for transport	3.4 m
Height installed (incl. CoolerTop®)	6.8 m
Length	12.8 m
Width	4.0 m

HUB DIMENSIONS

Max. transport height	3.74 m
Max. transport width	3.75 m
Max. transport length	5.42 m

BLADE DIMENSIONS

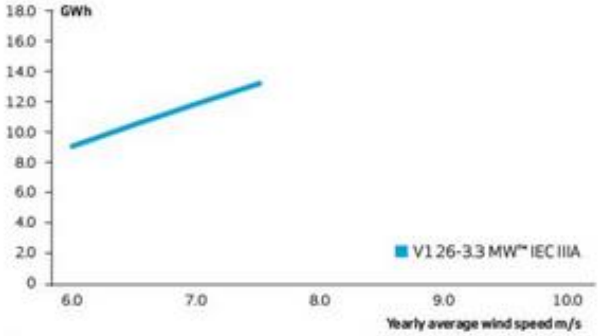
Length	61.7 m
Max. chord	4 m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- 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

3. MAIN COMPONENTS

3.1 Rotor

The V126-3.3/3.45 MW is equipped with a 126-meter rotor consisting of three blades and a hub. The blades are controlled based on wind conditions, so that they can be continuously positioned to optimise pitch angle.

3.2 Blades

The blades are made of carbon and fibreglass and consist of two infused structural airfoil shells. The blade length is 61.66 m.

3.3 Main shaft

The main shaft, made of cast iron, transmits the torque to the gearbox.

3.4 Gearbox

The gearbox converts the low-speed rotation of the rotor to high-speed generator rotation. It consists of two planetary stages and one helical stage.

3.5 Generator

The generator is a three phase asynchronous induction generator with cage rotor that is connected to the grid through a full scale converter.

3.6 Converter

The converter controls conversion of variable frequency power from the generator into fixed frequency power, adapting the energy delivered into the grid to the desired grid parameters and ensuring power quality.

3.5 Yaw System

The yaw system orients the turbine into the current wind direction by means of a number of yaw gears, powered by small motors, which engage a yaw ring underneath the nacelle.

3.6 Tower

The tower is a conical tubular steel configuration, with flange connections. The tower internals (including platforms, ladders and a service lift) provide a safe and easy access to the nacelle.

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4. OPERATION

The V126-3.3/3.45 MW is monitored and controlled by an independent control system. The control system is accessible both at the ground (at the tower base) and at the nacelle.

The control system ensures safe and optimum turbine operation, by performing the following main functions:

- Supervision and monitoring of turbine status and operation
- Control of blade pitch system
- Generator synchronization to the grid.
- Control of power production and variable speed operation.
- Nacelle yawing
- Control of noise emissions.
- Monitoring of ambient conditions
- Monitoring of safety systems.

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5. LIGHTNING PROTECTION SYSTEM

The V126-3.3/3.45 MW is equipped with a lightning protection system designed to protect mechanical components, electrical systems and control systems.

The Vestas lightning protection system provides both external and internal protection.

The external protection system handles direct lightning strikes and conducts the lightning current down into the earthing system below the tower; it includes elements such as blade lightning receptors or nacelle rods.

The internal protection system handles the induced magnetic and electric fields caused by a lightning strike; it includes elements such as shielded cables and surge protection devices.

The Vestas lightning protection system provides a Protection Level 1 (the highest specified level according to standard IEC 61400-24:2010) which ensures that Vestas wind turbines can endure high energy lightning strikes.

6.1 Protection by component

6.1.1 Blades

The blades are protected by an array of lightning receptors along the leading and trailing edges, on both sides of the blade. These receptors preferentially attract lightning resulting in few lightning attachment events to the glass shells or to the main portion of the blade.

The blades also include an internal down conductor, which consists of two insulated high voltage cables routed along the leading and trailing edges of the blade, which terminate at the lightning current transfer unit that connects blade and nacelle.

6.1.2 Nacelle

Lighting current transfer units ensure lightning currents are properly transferred from the blades to the nacelle structure and from the nacelle to the tower. In addition to this, the components in the nacelle are designed to withstand high-magnetic and electrical fields associated with lightning.

6.1.3 Cooler Top

The equipment placed on top of the cooler system is protected by use of rods and receptor rings. All metallic parts are equipotentially bonded to the interior steel structure of the nacelle.

6.1.4 Tower

The tower is designed to be the primary conductor of lightning current down to the earthing system.

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6.1.5 Earthing System

From a single wind turbine perspective, the earthing system principally consists of three individual earthings: the first is the foundation earthing itself, the second and third are the earth interconnection wires between each turbine and a horizontal earthing electrode.

In addition to this, all earthing electrodes are connected to a main earth bonding bar, placed at the cable entrance to the wind turbine, and equipotential connections are made to all cables entering or leaving the wind turbine.

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Attachment B

Henvey Inlet Wind Noise Modes

Vestas

Date
Portland, 1 September 2015

HENVEY INLET WIND

Noise Mode 0 – 3.3 MW

1/1 Octave Band Performance (with serrated trailing edges)

Frequency	Hub height wind speeds [m/s]																	
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s	14 m/s	15 m/s	16 m/s	17 m/s	18 m/s	19 m/s	20 m/s
8 Hz	34.1	32.7	31.8	33.6	36.0	38.3	39.7	40.3	41.5	42.4	43.0	43.6	44.0	44.4	44.7	45.0	45.2	45.6
16 Hz	53.9	52.9	52.4	54.5	57.5	60.4	62.5	63.2	63.8	64.2	64.6	64.8	65.0	65.2	65.3	65.6	65.7	65.8
31.5 Hz	66.2	65.3	64.8	66.7	69.3	71.8	73.5	74.2	75.0	75.7	76.1	76.5	76.9	77.1	77.3	77.5	77.7	77.9
63 Hz	78.5	77.9	77.8	79.1	81.1	82.8	84.2	84.7	85.1	85.4	85.6	85.8	86.0	86.1	86.2	86.3	86.4	86.5
125 Hz	84.3	84.1	84.4	85.9	87.8	89.7	91.1	91.6	91.7	91.7	91.8	91.8	91.9	91.9	91.9	92.0	92.0	92.0
250 Hz	87.9	88.0	88.5	90.6	93.1	95.5	97.4	98.1	97.9	97.8	97.8	97.7	97.7	97.6	97.6	97.6	97.6	97.6
500 Hz	85.8	85.7	86.4	89.9	93.8	97.3	100.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.1
1 kHz	85.0	84.8	85.6	89.4	93.6	97.4	100.3	101.3	101.4	101.3	101.3	101.4	101.4	101.4	101.4	101.4	101.4	101.5
2 kHz	85.1	85.1	85.8	88.3	91.3	94.0	96.1	96.8	96.7	96.6	96.6	96.5	96.5	96.5	96.5	96.5	96.5	96.5
4 kHz	80.6	80.9	81.5	83.3	85.4	87.5	89.0	89.5	89.2	89.0	88.8	88.7	88.7	88.6	88.5	88.5	88.4	88.4
8 kHz	65.3	65.9	66.7	67.2	67.9	68.7	69.5	69.6	68.8	68.0	67.6	67.3	67.1	66.9	66.7	66.5	66.3	66.3
A-wgt	93.2	93.2	93.7	96.4	99.6	102.7	105.1	106	106	106	106	106	106	106	106	106	106	106

Uncertainty

All required siting uncertainty is included in the above octave bands, and ranges from 0.6 to 1.2dB, depending on the frequency, with the largest values at low and high frequencies.

Tonal Audibility Level

The tonal audibility level will be within 3dB when determined according to the methods described in IEC 61400-11, Ed. 3, 2012.

Maximum Nameplate Power

3.3 MW

The noise data contained herein is estimated and no warranties are implied.

Date
Portland, 1 September 2015

HENVEY INLET WIND

Noise Mode 0 – 3.45 MW Power Mode

1/1 Octave Band Performance (with serrated trailing edges)

Frequency	Hub height wind speeds [m/s]																	
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s	14 m/s	15 m/s	16 m/s	17 m/s	18 m/s	19 m/s	20 m/s
8 Hz	34.1	32.4	31.6	33.5	36.0	38.3	39.7	40.2	41.1	42.2	42.9	43.4	43.8	44.3	44.7	44.9	45.1	45.5
16 Hz	54.0	52.7	52.2	54.5	57.5	60.4	62.5	63.2	63.7	64.2	64.5	64.8	64.9	65.2	65.3	65.5	65.6	65.8
31.5 Hz	66.3	65.1	64.7	66.7	69.3	71.8	73.5	74.2	74.8	75.6	76.0	76.4	76.7	77.1	77.3	77.4	77.5	77.9
63 Hz	78.9	78.3	77.9	79.1	81.1	82.8	84.2	84.7	85.0	85.4	85.6	85.7	85.9	86.1	86.2	86.3	86.3	86.5
125 Hz	84.8	84.6	84.4	85.8	87.8	89.7	91.1	91.7	91.7	91.8	91.8	91.9	91.8	92.0	92.0	92.0	91.9	92.0
250 Hz	88.2	88.3	88.6	90.5	93.1	95.5	97.4	98.1	97.9	97.9	97.8	97.8	97.7	97.7	97.7	97.6	97.5	97.6
500 Hz	85.3	85.1	86.2	89.8	93.8	97.3	100.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.1	101.1	101.0	101.1
1 kHz	84.3	84.1	85.4	89.4	93.6	97.4	100.3	101.4	101.3	101.4	101.4	101.4	101.4	101.5	101.5	101.5	101.4	101.5
2 kHz	85.1	85.1	85.7	88.3	91.3	94.0	96.1	96.8	96.7	96.7	96.6	96.6	96.5	96.6	96.5	96.5	96.5	96.5
4 kHz	81.1	81.4	81.7	83.3	85.4	87.5	89.0	89.6	89.3	89.1	88.9	88.9	88.6	88.6	88.6	88.5	88.4	88.5
8 kHz	66.6	67.3	67.1	67.2	67.9	68.7	69.5	69.8	68.9	68.3	67.8	67.5	67.2	67.0	66.8	66.7	66.4	66.3
A-wgt	93.2	93.2	93.7	96.4	99.6	102.7	105.1	106	106	106	106	106	106	106	106	106	106	106

Uncertainty

All required siting uncertainty is included in the above octave bands, and ranges from 0.6 to 1.2dB, depending on the frequency, with the largest values at low and high frequencies.

Tonal Audibility Level

The tonal audibility level will be within 3dB when determined according to the methods described in IEC 61400-11, Ed. 3, 2012.

Maximum Nameplate Power

3.45 MW

The noise data contained herein is estimated and no warranties are implied.

Vestas Americas
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Company Reg. Name: Vestas - American Wind Technology, Inc., Communication name: Vestas Americas

Date
Portland, 1 September 2015

HENVEY INLET WIND

Noise Mode 1 – 3.3 MW

1/1 Octave Band Performance (with serrated trailing edges)

Frequency	Hub height wind speeds [m/s]																	
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s	14 m/s	15 m/s	16 m/s	17 m/s	18 m/s	19 m/s	20 m/s
8 Hz	34.1	32.7	31.8	33.6	36.0	38.0	39.5	40.7	41.5	42.3	42.9	43.4	43.8	44.2	44.5	44.8	45.0	45.4
16 Hz	53.9	52.9	52.4	54.5	57.5	60.1	61.9	63.0	63.5	64.1	64.5	64.6	64.8	65.0	65.1	65.4	65.5	65.6
31.5 Hz	66.2	65.3	64.8	66.7	69.3	71.5	73.1	74.3	74.9	75.6	76.0	76.3	76.7	76.9	77.1	77.3	77.5	77.7
63 Hz	78.5	77.9	77.8	79.1	81.1	82.6	83.8	84.6	84.9	85.2	85.4	85.6	85.8	85.9	86.0	86.1	86.2	86.3
125 Hz	84.3	84.1	84.4	85.9	87.8	89.5	90.6	91.2	91.4	91.6	91.7	91.6	91.7	91.7	91.7	91.8	91.8	91.8
250 Hz	87.9	88.0	88.5	90.6	93.1	95.3	96.8	97.3	97.6	97.7	97.7	97.5	97.5	97.4	97.4	97.4	97.4	97.4
500 Hz	85.8	85.7	86.4	89.9	93.8	97.0	99.2	100.1	100.5	100.8	100.8	100.8	100.8	100.8	100.8	100.8	100.8	100.9
1 kHz	85.0	84.8	85.6	89.4	93.6	97.1	99.4	100.5	100.9	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.3
2 kHz	85.1	85.1	85.8	88.3	91.3	93.8	95.4	96.1	96.3	96.5	96.4	96.3	96.3	96.3	96.3	96.3	96.3	96.3
4 kHz	80.6	80.9	81.5	83.3	85.4	87.3	88.5	88.8	88.8	88.8	88.7	88.5	88.5	88.4	88.3	88.3	88.2	88.2
8 kHz	65.3	65.9	66.7	67.2	67.9	68.6	69.1	68.8	68.3	67.9	67.5	67.1	66.9	66.7	66.5	66.3	66.1	66.1
A-wgt	93.2	93.2	93.7	96.4	99.6	102.5	104.4	105.2	105.6	105.8	105.8	105.8	105.8	105.8	105.8	105.8	105.8	105.8

Uncertainty

All required siting uncertainty is included in the above octave bands, and ranges from 0.6 to 1.2dB, depending on the frequency, with the largest values at low and high frequencies.

Tonal Audibility Level

The tonal audibility level will be within 3dB when determined according to the methods described in IEC 61400-11, Ed. 3, 2012.

Maximum Nameplate Power

3.3 MW

The noise data contained herein is estimated and no warranties are implied.

Vestas Americas

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Date
Portland, 1 September 2015

HENVEY INLET WIND

Noise Mode 2 – 3.175 MW

1/1 Octave Band Performance (with serrated trailing edges)

Frequency	Hub height wind speeds [m/s]																	
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s	14 m/s	15 m/s	16 m/s	17 m/s	18 m/s	19 m/s	20 m/s
8 Hz	34.1	32.7	31.8	33.6	36.2	37.9	38.5	38.8	39.9	40.9	41.8	42.6	42.9	43.3	43.6	43.9	44.3	44.4
16 Hz	53.9	52.9	52.4	54.5	57.6	59.7	60.4	60.7	61.5	62.3	63.0	63.5	63.7	63.9	64.1	64.3	64.4	64.5
31.5 Hz	66.2	65.3	64.8	66.8	69.4	71.3	71.9	72.2	73.1	74.0	74.7	75.3	75.6	75.8	76.1	76.3	76.5	76.6
63 Hz	78.5	77.9	77.8	79.1	81.1	82.5	82.9	83.1	83.7	84.1	84.5	84.9	84.9	85.0	85.2	85.3	85.4	85.4
125 Hz	84.3	84.1	84.4	85.8	87.8	89.2	89.6	89.8	90.2	90.4	90.6	90.8	90.8	90.8	90.9	90.9	90.9	90.9
250 Hz	87.9	88.0	88.5	90.5	93.1	94.8	95.4	95.6	95.9	96.1	96.3	96.5	96.4	96.3	96.4	96.3	96.3	96.2
500 Hz	85.8	85.7	86.4	89.9	93.8	96.3	97.2	97.6	98.2	98.6	99.0	99.4	99.4	99.4	99.5	99.5	99.5	99.4
1 kHz	85.0	84.8	85.6	89.4	93.6	96.3	97.3	97.7	98.3	98.8	99.3	99.7	99.8	99.8	99.9	99.9	99.9	99.8
2 kHz	85.1	85.1	85.8	88.3	91.3	93.2	93.9	94.1	94.5	94.8	95.0	95.3	95.2	95.1	95.2	95.2	95.2	95.1
4 kHz	80.6	80.9	81.5	83.3	85.4	86.8	87.3	87.4	87.6	87.6	87.7	87.8	87.5	87.4	87.4	87.4	87.3	87.2
8 kHz	65.3	65.9	66.7	67.1	67.9	68.3	68.4	68.3	68.0	67.5	67.1	66.8	66.3	66.0	65.9	65.8	65.6	65.4
A-wgt	93.2	93.2	93.7	96.4	99.6	101.8	102.6	102.9	103.4	103.8	104.2	104.5	104.5	104.5	104.5	104.5	104.5	104.5

Uncertainty

All required siting uncertainty is included in the above octave bands, and ranges from 0.6 to 1.2dB, depending on the frequency, with the largest values at low and high frequencies.

Tonal Audibility Level

The tonal audibility level will be within 3dB when determined according to the methods described in IEC 61400-11, Ed. 3, 2012.

Maximum Nameplate Power

3.175 MW

The noise data contained herein is estimated and no warranties are implied.

Vestas Americas

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Date
Portland, 1 September 2015

HENVEY INLET WIND

Noise Mode 3 – 2.979 MW

1/1 Octave Band Performance (with serrated trailing edges)

Frequency	Hub height wind speeds [m/s]																	
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s	14 m/s	15 m/s	16 m/s	17 m/s	18 m/s	19 m/s	20 m/s
8 Hz	34.1	32.7	31.9	34.0	36.4	37.1	37.0	37.2	38.2	39.4	40.8	41.2	41.6	41.9	42.2	42.6	42.9	43.2
16 Hz	53.9	52.9	52.4	54.8	57.4	58.2	58.3	58.6	59.5	60.4	61.5	61.8	62.0	62.2	62.4	62.6	62.7	62.9
31.5 Hz	66.2	65.3	64.8	67.0	69.4	70.1	70.2	70.4	71.3	72.2	73.5	73.8	74.0	74.3	74.5	74.7	75.0	75.2
63 Hz	78.5	77.9	77.8	79.3	80.9	81.5	81.6	81.7	82.3	82.8	83.7	83.7	83.7	83.8	83.9	84.0	84.1	84.2
125 Hz	84.3	84.1	84.4	85.8	87.4	87.9	88.1	88.4	88.8	89.1	89.7	89.6	89.5	89.5	89.5	89.5	89.5	89.6
250 Hz	87.9	88.0	88.5	90.4	92.5	93.1	93.4	93.8	94.2	94.5	95.1	95.0	94.8	94.8	94.7	94.7	94.7	94.6
500 Hz	85.8	85.7	86.4	89.8	93.0	94.0	94.3	94.9	95.6	96.2	97.1	97.3	97.3	97.4	97.4	97.4	97.4	97.4
1 kHz	85.0	84.8	85.6	89.3	92.8	93.9	94.3	94.8	95.6	96.3	97.2	97.4	97.5	97.6	97.6	97.6	97.6	97.6
2 kHz	85.1	85.1	85.7	88.2	90.6	91.4	91.7	92.1	92.6	92.9	93.6	93.6	93.5	93.5	93.4	93.4	93.4	93.4
4 kHz	80.6	80.9	81.5	83.1	84.8	85.3	85.6	85.9	86.1	86.2	86.7	86.4	86.2	86.1	86.0	85.9	85.8	85.8
8 kHz	65.3	65.9	66.7	66.7	67.1	67.2	67.5	67.8	67.5	67.0	66.9	66.2	65.7	65.3	65.1	64.9	64.8	64.6
A-wgt	93.2	93.2	93.7	96.3	98.9	99.8	100.1	100.5	101.2	101.7	102.5	102.5	102.5	102.5	102.5	102.5	102.5	102.5

Uncertainty

All required siting uncertainty is included in the above octave bands, and ranges from 0.6 to 1.2dB, depending on the frequency, with the largest values at low and high frequencies.

Tonal Audibility Level

The tonal audibility level will be within 3dB when determined according to the methods described in IEC 61400-11, Ed. 3, 2012.

Maximum Nameplate Power

2.979 MW

The noise data contained herein is estimated and no warranties are implied.

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Date
Portland, 1 September 2015

HENVEY INLET WIND

Noise Mode 4 – 1.325 MW

1/1 Octave Band Performance (with serrated trailing edges)

Frequency	Hub height wind speeds [m/s]																	
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s	14 m/s	15 m/s	16 m/s	17 m/s	18 m/s	19 m/s	20 m/s
8 Hz	34.1	32.7	31.8	33.5	34.2	36.0	37.3	38.2	38.9	39.4	39.9	40.2	40.6	40.9	41.3	41.5	41.8	42.1
16 Hz	53.9	52.9	52.4	54.4	55.8	56.8	57.6	58.2	58.6	58.9	59.3	59.5	59.7	59.9	60.1	60.3	60.5	60.7
31.5 Hz	66.2	65.3	64.8	66.7	67.6	69.0	69.9	70.5	70.9	71.4	71.7	71.9	72.1	72.4	72.6	72.8	73.0	73.2
63 Hz	78.5	77.9	77.8	79.1	79.9	80.7	81.0	81.4	81.6	81.8	82.0	82.1	82.2	82.3	82.4	82.5	82.6	82.8
125 Hz	84.3	84.1	84.4	85.8	86.8	87.1	87.2	87.2	87.3	87.3	87.4	87.4	87.4	87.5	87.5	87.5	87.5	87.6
250 Hz	87.9	88.0	88.5	90.5	92.0	92.0	91.8	91.7	91.7	91.7	91.7	91.6	91.6	91.5	91.5	91.5	91.4	91.4
500 Hz	85.8	85.7	86.4	89.8	92.0	92.3	92.3	92.3	92.3	92.3	92.4	92.4	92.3	92.3	92.4	92.4	92.4	92.4
1 kHz	85.0	84.8	85.6	89.3	91.7	92.0	92.0	92.1	92.1	92.1	92.2	92.2	92.1	92.1	92.2	92.2	92.2	92.2
2 kHz	85.1	85.1	85.8	88.3	90.0	90.1	90.0	89.9	89.8	89.8	89.9	89.8	89.8	89.8	89.8	89.7	89.8	89.7
4 kHz	80.6	80.9	81.5	83.3	84.7	84.4	84.1	83.9	83.8	83.7	83.6	83.6	83.5	83.4	83.4	83.3	83.3	83.3
8 kHz	65.3	65.9	66.7	67.2	68.1	67.0	66.1	65.7	65.4	65.2	65.0	64.9	64.7	64.5	64.5	64.4	64.4	64.3
A-wgt	93.2	93.2	93.7	96.3	98.2	98.3	98.3	98.3	98.3	98.3	98.3	98.3	98.3	98.3	98.3	98.3	98.3	98.3

Uncertainty

All required siting uncertainty is included in the above octave bands, and ranges from 0.6 to 1.2dB, depending on the frequency, with the largest values at low and high frequencies.

Tonal Audibility Level

The tonal audibility level will be within 3dB when determined according to the methods described in IEC 61400-11, Ed. 3, 2012.

Maximum Nameplate Power

1.325 MW

The noise data contained herein is estimated and no warranties are implied.

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