Section 27
Public Safety

PATRIOT RENEWABLES
Canton Mountain Wind, LLC

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27.0 PUBLIC SAFETY

27.1 Introduction

The Canton Mountain Wind Project (Project) has been designed to comply with safety setback requirements mandated by Maine's Site Location of Development Act (Site Law). The Project has been designed with seven GE 2.75-103 and one GE 2.75-100, 2.75-megawatt (MW) turbines. These turbine models are an upgrade of GE's 2.5xl 2.5-MW turbine; all turbines have the same major components but the GE 2.75 series has a higher nameplate capacity and slightly larger rotor diameter. The 2.75-103 has 103-meter-diameter rotors (338 feet) mounted on 85-meter (278.8 feet) towers, while the 2.75-100 is the same turbine with a slightly smaller rotor diameter of 100 meters. The height from the ground to the tip of a blade at its highest point is 136.5 meters (448 feet) for a GE 2.75-103 turbine.

The Project may alternately use the Gamesa G90 2.0-MW turbine, which has a 90-meter (295-foot) rotor mounted on a 78-meter (256-foot) tower, for a total tip height of 123 meters (404 feet).

Canton Mountain Wind, LLC (CMW) has included the design safety certification, evidence of over-speed control design and function, and associated public safety-related setbacks for these GE and Gamesa turbines to provide evidence that the Project will not pose an unreasonable public safety risk and will conform to international safety standards. All setbacks have been calculated based on the tallest turbine: GE 2.75-103.

27.2 Design Safety Certification

TUV NORD has independently certified GE's 2.5xl turbine for Class IIB and IIIA extreme 50-year wind gusts (see Attachment 27-1), as established by the International Electrotechnical Commission (IEC). The certification for the GE 2.75 series turbines is expected to be available in the first quarter of 2012. CMW will provide the model-specific design certification when it becomes available. The Gamesa G90 turbines are designed for extreme 50-year wind gusts of 133 miles per hour (mph) and Class IIA winds, as established by the International Electrotechnical Commission (IEC). The type certification by Germanischer Lloyd, the leading wind power product certification authority, for the Gamesa G90 turbines is included as Attachment 27-2.

27.3 Overspeed Control

27.3.1 GE 2.5X

Safety and overspeed control features for the GE 2.75 series turbines are referenced in Attachment 27-3. The braking system is the same for the 2.5-MW and the 2.75-MW turbines.

27.3.2 Gamesa G90-2.0 MW Turbines

A series of sensors in the Gamesa G90 series turbines constantly monitors wind and turbine conditions so the turbines can react to vibration and overspeed. Sensors within the nacelle will trigger braking if any of the following conditions occur:

- the rotor is spinning overspeed (1.155 times nominal speed for 200 milliseconds)
- the generator is spinning overspeed (1.083 times nominal speed for 200 milliseconds)
- there is a vibration beyond set tolerance levels

- there is a failure in the hydraulic pitch mechanism
- control systems fail

The Gamesa G90 series turbines incorporate a robust overspeed protection system with redundant controls. There are two independent methods of speed control in each turbine: blade pitch control and hydraulic disc braking. Either or both of these systems can activate to prevent overspeed.

The turbine's primary braking system is the aerodynamic brake activated by pitching the turbine blades out of the wind. Each blade is controlled by an independent hydraulic actuator, and each actuator is backed up by a hydraulic accumulator that stores hydraulic fluid under pressure at all times. During an emergency shutdown, a valve is activated that releases the stored energy of this fluid and pitches the blade out of the wind. A single blade pitched out of the wind provides sufficient aerodynamic braking to stop the other two blades; therefore, the three independent systems provide redundant safety mechanisms. During a normal shutdown, the hydraulic actuators act to pitch the blades out of the wind. In the event of a failure of this system, such as a grid power loss or activation of an emergency stop button, the hydraulic accumulators are activated.

27.4 Public Safety Setbacks

The Project has been sited with appropriate safety-related setbacks. Maine Department of Environmental Protection requires a setback of 1.5 times the maximum tip height of the turbine from abutting property lines, which is 672 feet (204.75 meters) for the GE 2.75-103 turbines.

Table 27-1. Turbine Locations and Setbacks from Surveyed Property Boundaries

Turbine	Turbine Coordinates		Turbine Model	Distance to Closest Property Boundary (feet)
	Latitude	Longitude		
1	44° 31' 15.32" N	70° 18' 02.93" W	GE 2.75-103	702
2	44° 31' 06.58" N	70° 18' 04.96" W	GE 2.75-103	960
3	44° 30' 59.09" N	70° 18' 08.23" W	GE 2.75-103	1,291
4	44° 30' 52.66" N	70° 18' 11.49" W	GE 2.75-103	1,606
5	44° 30' 45.86" N	70° 18' 14.10" W	GE 2.75-103	1,884
6	44° 30' 37.92" N	70° 18' 13.88" W	GE 2.75-103	1,981
7	44° 30' 27.47" N	70° 18' 12.87" W	GE 2.75-103	2,058
8	44° 30' 26.93" N	70° 18' 37.23" W	GE 2.75-100	2,600

PATRIOT RENEWABLES
Canton Mountain Wind, LLC

Attachment 27-1
TUV NORD Statement of Compliance for the GE 2.5xl Turbine

Statement of Compliance for the A-Design Assessment

Registration-No.
44 220 10196537-DA-GL, Rev. 0

Name and address of customer

GE Energy GmbH
Holsterfeld 16
48499 Salzbergen
GERMANY

Wind Turbine

GE 2.5xl, 60 Hz, hh 85 m
LM 48.7 P / GE 48.7

with the characteristic data given in the attached "Annex to Design Assessment"
has been assessed by TÜV NORD concerning the design.

Assessed acc. to

WTGS Class IEC IIB / IIIA

The design approval is based on the indicated documents as follows:

TÜV NORD	Report No. 8000 196 537/1 E	Load assumptions IEC 61400-1, (1999) WTGS Class IIB/IIIA	Rev.0	dated Jan. 2010
TÜV NORD	Report No. 8000 196 537/2 E	Safety system and manuals	Rev.0	dated Jan. 2010
TÜV NORD	Report No. 8000 196 537/3 E	Rotor blades LM 48.7 P and GE 48.7	Rev.0	dated Jan. 2010
TÜV NORD	Report No. 8000 196 537/4 E	Machinery components	Rev.0	dated Feb. 2010
TÜV NORD	Report No. 8000 196 537/5 E	Electrical systems	Rev.0	dated Jan. 2010
TÜV NORD	Report No. 8000 196 537/6 E	Tubular steel tower hh 85 m NAMTS	Rev.0	dated Jan. 2010
TÜV NORD	Report No. 8000 196 537/9 E	Commissioning	Rev.0	dated Jan. 2010
TÜV NORD	Report No. 8000 196 537/12 E	Nacelle cover and spinner	Rev.0	dated Jan. 2010

Normative references: **Certification scheme:**
Germanischer Lloyd WindEnergie GmbH "Guideline for the Certification of Wind Turbines", Edition 2003 with Supplement 2004
in combination with
IEC 61400-1 "Wind turbine generator systems - part 1: Safety requirements", Second Edition, 1999-02.

fletr

TÜV NORD

Any change in the design is to be approved by TÜV NORD. Without approval this Statement loses its validity.

Please also pay attention to the information stated overleaf

TÜV NORD CERT GmbH
Certification Body for
Wind Turbines

Dipl.-Ing. Werner Petruschke

Deutscher Akkreditierungs Rat
DAR
DAP-ZE-2016.80

Essen, 04th February 2010

Langemarckstraße 20 • 45141 Essen • Fon +49 (0)40 8557-2417 • Fax +49 (0)40 8557-2552

Annex to A-Design Assessment

No. 44 220 10196537-DA-GL, Rev. 0

Principle technical turbine data of the GE 2.5xl, 50/60 Hz, hh 85 m

Main data	Type	Horizontal axis wind turbine with variable rotor speed
	Rotor diameter	100 m
	Power regulation	Independent electromechanical pitch system for each blade
	Rated power	2500 kW
	Hub height	85 m
	Rated rotational speed	14.05 rpm
	Operating range rotational speed	3.83 ... 15.61 rpm
	Cut-in wind speed	3.0 m/s
	Rated wind speed	12.0 m/s
	Cut-out-wind speed (10 min mean)	25 m/s
	Extreme wind speed (50-year-wind)	42.5 m/s (IEC IIB) 37.5 m/s (IEC IIIA)
	Annual average wind speed	8.5 m/s (IEC IIB) 7.5 m/s (IE
	Design life time	20 years
	IEC 61400-1, class	**IIB and IIIA**
Nacelle	Manufacturer	GE Energy
	Drawing No.	115W1980
Nacelle cover	Manufacturer	Jupiter Plast
	Drawing No.	102W3918 102W3921 115W1941 115W6941 115W6508 115W6566
Spinner	Manufacturer	GE Energy
	Drawing No.	114W4337 102W1378 102W2271
Rotor	Cone angle	3°
	Tilt	4°
	Blade pitch angle	Variable
	Orientation	Upwind
Blade	Type	LM 48.7 P
	Material	Glass fibre reinforced polyester
	Blade length	48.7 m
	Number of Blades	3
	Manufacturer	LM Glasfib er
	Drawing No.	DR-02557 Eng change Id.: 21351

	alternative:	
	Type	GE 48.7
	Material	Glass fibre reinforced epoxy
	Blade length	48.7
	Number of blades	3
	Manufacturer	GE Energy
	Drawing No.	103W1687
Pitch gear	Manufacturer	s.me.i
	Type	RES1300GR3S
	alternative:	
	Manufacturer	Liebherr
	Type	DAT300/484
Hub	Type	Cast
	Material	EN-GJS-400-18U-LT
	Drawing No.	115 W 6058
Main shaft	Type	Forged
	Material	34CrNiMo6
	Drawing No.	115W1655
Main bearing front	Design	Tapered roller bearing
	Type	808471A
	Manufacturer	F.A.G
	alternative:	
	Design	Tapered roller bearing
	Type	F-572912.TR2
	Manufacturer	F.A.G
Main bearing rear	Design	Cylindrical roller bearing
	Type	F-808599.NU30/710
	Manufacturer	F.A.G
Gearbox	Manufacturer	Winergy
	Type	PFZB 3494.0
	Ratio	1:117.249
	alternative:	
	Manufacturer	Bosch-Rexroth
	Type	GPV 530 D
	Ratio	1:117.315
Mechanical brakes	No of callipers	1
	Position	High speed shaft of main gear
	Manufacturer	Svendborg Brakes
	Type	BSAK 3000-MS 40 S-100
Flex Coupling	Manufacturer	ATEC
	Type	ARW-4 KRZK 520-4

Yetr

	alternative:	
	Manufacturer	KTR
	Type	RADEX-N220 NANA 4 spec.
Generator	Manufacturer	ABB
	Type	AMG 0500LN08 AAM (Permanent magnet synchronous generator)
	Rated Power	2640 kW
	Rated speed	1650 rpm
	Isolation class	F
	Degree of protection	IP 55
Transformer	Manufacturer	Hainan Jinpan Electric
	Type	dry type cast resin
	Drawing No.	manufacture: 3TO1620700 GE: 10745099P345
	Rated power	2.300/2.800 kVA
	Rated voltage LV	0.69 kV
	Rated voltage HV	34.5kW
Medium Voltage Switchgear	Manufacturer	Schneider
	Type	DVCAS
	Rated voltage	38 kV
Converter	Manufacturer	GE
	Drawing No.	151X1227CA41AA01 151X1227MZ04AA54
Main frame	Type	Cast
	Material	EN-GJS-400-18U-LT
	Drawing No.	115W2170, 3 sheets 115W2171, 2 sheets
Yaw system	Type	Active, 4 yaw drives 5 active hydraulic brakes with ball bearing
	Manufacturer	Liebherr
	Type	Ball Bearing Slewing Ring
	Drawing No.	KUD 748VA802-000
	alternative:	
	Manufacturer	Rothe Erde
	Type	Ball Bearing Slewing Ring
	Drawing No.	061.60.2791.100.68.1512
Generator frame	Type	Weldment
	Material	S355 J2G3
	Drawing No.	115W6543 115W6544
Yaw gear	Manufacturer	s.me.i
	Type	RES 6000 GR4-KT
	Drawing No.	908050 (50 Hz) 908060 (60 Hz)

Annex to A-Design Assessment

No. 44 220 10196537-DA-GL, Rev. 0

Yaw brake	Manufacturer	Svendborg Brakes
	Type	BSAB 120
Tower	Design	Tubular steel tower with 4 sections
	Length	80.86 m
	Drawing No.	123W1169
Control and safety system	Manufacturer	GE Energy

End of Annex

TÜV NORD CERT GmbH
Certification Body for
Wind Turbines

Dipl.-Ing. Werner Petruschke

Deutscher Akkreditierungs Rat

DAP-ZE-2016.80

Essen, 04th February 2010

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PATRIOT RENEWABLES
Canton Mountain Wind, LLC

Attachment 27-2
GL Certification of the Gamesa G90-2.0 MW Wind Turbine

Type Certificate

GL Renewables Type Certificate No. **TC-GL-005A-2010, Revision 2**

We hereby certify that the Wind Turbine Type

Gamesa G90-2.0 MW IEC IIA 50 / 60 Hz

by

Gamesa Innovation and Technology, S.L.
Ciudad de la Innovación 9-11
31621 Sarriguren (Navarra)
Spain

has been assessed by Germanischer Lloyd concerning the system design, the Implementation of the design requirements in Production and Erection (IPE), the prototype testing and the manufacturer's quality system.

The Type Certificate is based on the indicated documents as follows:

DAA-GL-004-2010, Revision 2	Statement of Compliance for the A-Design Assessment 50 / 60 Hz dated 31st March 2011
PT-GL-003-2010, Revision 1	Statement of Compliance for the Prototype Testing 50 / 60 Hz dated 31st March 2011
IPE-GL-008-2008, Revision 1	Statement of Compliance for the Implementation of the design-related requirements in Production and Erection 50 / 60 Hz dated 1st November 2010, valid until 31st October 2012
Certificate No: SGI 1957808	"Certificate for the Quality Management System" issued by LRQA, Ltd. Operaciones España dated 1st January 2010, valid until 31st December 2012
Normative references:	"Guideline for the Certification of Wind Turbines", Edition 2003 with Supplement 2004, of Germanischer Lloyd

Changes of the system design, the production and erection or the manufacturer's quality system are to be approved by Germanischer Lloyd; otherwise this Type Certificate loses its validity.

This Type Certificate is valid until **31st October 2012**, provided that a valid "Statement of Compliance for the Implementation of design-related requirements in Production and Erection" and a valid "Certificate for the Quality Management System" are available for this period.

Hamburg, 31st March 2011
Manj

Germanischer Lloyd Industrial Services GmbH

i. V. Mike Woebbeking

i. V. Andreas Anders

By DAkkS according DIN EN 45011 / IEC/ISO Guide 65
accredited Certification Body for products
The accreditation is valid for the fields of certification
listed in the certificate

DAkkS
Deutsche
Akkreditierungsstelle
D-ZE-11053-01-00

Germanischer Lloyd Industrial Services GmbH
Renewables Certification
Brooktorkai 18
20457 Hamburg, Germany

The latest edition of the "General Terms and Conditions of Germanischer Lloyd Industrial Services GmbH" is applicable. German law applies.

PATRIOT RENEWABLES
Canton Mountain Wind, LLC

Attachment 27-3
GL Certification of the Brakes Description for the GE 2.5-100

Certification:

GE will provide an A-DA Certificate for 2.75-103 in October 2011.

2.5-2.75 Series Brake Description

4.1.9 Brake Devices

4.1.9.1 Pitch System

The control system continuously monitors the functionality of the pitch system. If one of the following malfunctions occur, the turbine will be shut down according to the Braking Procedure

1. Communication between the pitch controller and programmable controller via the CAN-bus interface for timeout and accuracy and/or plausibility of the transmitted data. If there is a communication timeout of more than 0,45 sec or if an erroneous data transmission occurs three times in a row (length, plausibility, checksum of telegram), a shutdown is initiated.

2. Actual angle values from integrated encoder of the pitch drives and the real time blade angle from the limit switch at ϑ b2 are compared by the pitch system internally. In case of a deviation greater than $\Delta\vartheta$ the pitch system sends a fault message to the EC, which initiates a shutdown.

3. The EC also monitors the real time actual values of the blade angles. It initiates a shutdown of the turbine if the difference between the current real value and an expected value (in the following referred to as “pitch-difference”) is greater and lasts longer than in the following combinations:
_ The “pitch-difference” is > $\Delta\vartheta_1$ in a time period of $t_{\Delta\vartheta 1}$.
_ The “pitch-difference” is > $\Delta\vartheta_2$, in a time period of $t_{\Delta\vartheta 2}$.
In order to compare the behavior of the blades the “pitch-differences” of the three blades are compared among each other. If one of these comparisons exceeds the following combinations of value and time "blade angle asymmetry" is triggered and a shut down is initiated:
_ An asymmetry of > $\Delta\vartheta_3$ occurs in a time period of $t_{\Delta\vartheta 3}$.
_ An asymmetry of > $\Delta\vartheta_4$ occurs in a time period of $t_{\Delta\vartheta 4}$.

4. Independent of the main EC software program, a separate program in the EC ensures that there is no negative pitch rate longer than t_{T3} with increase in speed. Exceeding the limit causes braking procedure No.6.2 (pitch runaway).

5. If the limit switch position at -5°, 89°, 94 ° does not plausibly coincide with the actual blade angle values, shutdown is initiated by braking procedure No.4.

Batteries for emergency pitch operation are checked every 168 hours (1 week) for their load status. There is switchover to battery operation upon the control system request. The blades are moved independently one after the other with a braked rotor between ϑ_4 and ϑ_2 while monitoring pitch speed. Redundantly there is a system for continuous monitoring of the load status.
After a significant duration of grid loss of more than 1 hour (monitored by the EC) and outside temperature of less than 0℃ the batteries are chec ked. During standstill of the turbine the blades are driven independently into 0° position and battery d rive is released. Battery voltage and pitch rate is monitored. If these values are not sufficient restart of the turbine is blocked.

4.1.9.2 Battery charger and diagnostics (GE-Pitch-system)
The general control strategy for the GE-Pitch-system is described as follows. The chargers perform a load test every 30 minutes, which consists of placing a small load resistor across the battery and measuring the resulting dV/dT. The chargers also report the active charging mode to the system which is either constant current, constant voltage or float mode. The system generates a battery charging fault if the charger is in constant current mode for more than 30 minutes.

4.1.9.3 Battery charger and diagnostics (SSB-Pitch-system)
Deleted – SSB not available in NA

Parallel to the regularly weekly check of the battery capacity (see 4.1.9.1) there is a permanent monitoring process. Therefore a current pulse is drawn from the battery. The load shall be designed for maximum pulse current of 1.6A or a load resistance of 100Ω for a maximum of 2 seconds with a 4…7 minutes repetition rate. The battery voltage is to be measured at the later end of a battery load test-pulse. This monitors the vitality of the battery. In case of limited capacity the drawn current pulse would initiate a significant voltage drop.

4.1.9.4 Disc Brake
The disc brake and the hydraulic system are monitored in multiple ways:

Supervision of braking time:
12 seconds after applying of brake procedure 6.x the speed of the turbine is checked. Should it be above 80rpm, the turbine will be shut down with braking procedure 6.2, displaying error message 27 'Secondary braking time too long'.

Supervision of speed reduction:
The speed reduction of the turbine is monitored each time the brake is applied (braking procedures 6.x). 5 seconds after applying the brake the speed has to be below the speed at initialization of the brake procedure. In addition, 5 seconds after the init of the brake procedure, the speed reduction is monitored every 500ms. Should this supervision fail, the turbine will be stopped with the braking procedure 6.2 and will generate the error message 28 'No speed reduction with secondary braking.

Supervision of brake not opening:
Whenever the controller opens the brake, the 'open' state is constantly checked. If the brake's feedback contact indicates a closed brake the turbine is shut down with braking procedure 4, generating the message 34 'Brake not released.

Supervision of brake not closing:
Whenever the controller closes the brake, the 'close' state is constantly checked. If the brake's feedback contact indicates an opened brake the turbine is shut down with braking procedure 4, generating the message 157 'Brake does not close.

Supervision of speed with braked turbine:
60 seconds after closing the brake the speed of the turbine is constantly monitored. Should it exceed 30rpm on the generator side or 1.5rpm on the rotor side, the turbine will be shut down with braking procedure 6.3. Error message 36 'Speed with braked turbine' will be generated.

Supervision of brake pad wear:
The brake pad thickness is checked each time the brake is closed. Two levels of wear are monitored. Message 302 'Brake pad worn, warning' is displayed as soon as the warning level is reached, the turbine is not stopped with this message. Message 86 'Brake pads worn, secondary brake' is generated when the pads reach the 'worn' level. In this case the turbine is stopped with braking procedure 2.

Supervision of hydraulic pump operation time, leakage check 1:
The activation time of the hydraulic pump is constantly checked. If it is activated for a period longer 30 seconds without building up a sufficient pressure, the message 45 'Hydraulic pump time too long' is activated and the turbine is stopped with braking procedure 2.

Supervision of hydraulic pump interval time, leakage check 2:
If the hydraulic pump is started more than 4 times in 50 seconds the turbine is stopped with braking procedure 2, generating message 46 'Hydraulic pump time too short.

Test of hydraulic accumulator:
Each month the hydraulic accumulator is tested by the controller. The pump is switched off and the system pressure is checked after one minute If the pressure falls below the warning level but stays above the fault level, message 281 'Prepressure warning, active brake' will be displayed. In this case the restart of the turbine will not be blocked. If the pressure falls below the fault level, message 282 'Prepressure error, active brake' will be displayed and the turbine will be stopped with brake procedure 2.