



Ball Hill Wind Project Operations and Maintenance Plan

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Operational Plan Overview

An Operations and Maintenance Plan is a dynamic project-specific plan that is typically created based on the specific turbine selected, the turbine manufacturer, and other project-specific considerations i.e., Substation and Balance of Plant (BOP) equipment. This Operations and Maintenance Plan (O&M Plan) will be implemented at the Ball Hill Wind Project (the “Project”) once it becomes operational and reflects typical O&M maintenance requirements based on the experience of Northland Power, Inc (NPI) and its affiliates.

Vestas, which is the Original Equipment Manufacturer (OEM) company of the turbines installed at the Project, has entered a twenty (20) year Service Maintenance Agreement (SMA) and will be responsible for the Plan’s implementation associated with the turbine’s operation and maintenance. The Project’s on-site NPI team will be responsible for the plans implementation associated with annual blade inspections as well as with the Balance of Plant (BOP) and Substation.

The objective of the O&M Plan is to optimize the Project’s operational capacity and availability through best-in-class maintenance guidelines and inspections that are designed to pro-actively detect any significant safety or maintenance issues

O&M Responsibilities

Wind turbine generators (WTGs) require periodic preventative maintenance as well as corrective maintenance in the event a material deficiency is identified within an individual generator that requires repair. In addition, the electric collection system that ties the generators together as well as the substation that steps up voltage for delivery to the bulk electric system, require periodic maintenance and may require corrective maintenance.

Balance of Plant

For BOP operations and maintenance (O&M), NPI will assign qualified employees to the Project to operate the Facility in accordance with New York Independent System Operator (NYISO) protocol requirements and all requirements of the North American Electric Reliability Corporation (NERC). NPI is a company with great experience bringing utility-scale wind generation to the market, NPI is comfortable with the regulatory hurdles necessary to commission and operate a wind power facility. See table 1 through 17 for maximum maintenance frequencies of BOP and Substation items

Turbines

The Project’s turbines will require preventative maintenance at an average interval of annually except for the first year when a three-month, post commissioning, break in maintenance will be completed on each turbine. Because each turbine will be limited to approximately 40 hours of service maintenance time per year, the maintenance cycle for a facility of this size may take up to 30 weeks to complete, (26 weeks service

maintenance plus 4 weeks for delays such as weather, holidays, and correctives). Only one turbine, at a time, will be taken out of service during the service maintenance cycles. The general maintenance requirements and time intervals for wind turbine maintenance are outlined in the table below.

Summary of General Maintenance Requirements and Intervals for Turbines

System and Interval	Break in Maintenance 90 Days *	Semi-Annually	Annually
Prepare for Service	X		X
Functional Safety Test			X
Safety Equipment			X
Rotor	X		X
Hydraulic Systems	X		X
Gear Box and Gear Oil System	X		X
Generator and Coupling	X		X
Cooling and Conditioning	X		X
Nacelle			X
Yaw System	X		X
Service Crane	X		X
High Voltage	X		X
Service lift or Climb Assist			X
Tower	X		X
Finish work	X		X
Ping test base bolts			X
Blade inspections (NPI) per Article 10 Certificate Condition 143			X
Turbine Switchgear Thermography (NPI)		X	
Junction Box Thermography (NPI)		X	

*One time only maintenance, 90 days after commissioning (Break in Maintenance)

These maintenance periods are typically performed outside of high-wind season and are completed as quickly as possible by using on-site personnel, equipment, and regional resources as needed. Vestas will be under continuous evaluation by the on-site NPI employees and will be responsible for service and repairs under the SMA for a minimum of twenty years. During this period, Vestas will maintain on-site staff for on-call, emergency, and scheduled work. These personnel will work under their own supervision and in addition the Project's asset management and operations staff will monitor the service providers adherence to the SMA. Vestas has a strong presence and operations capability in the region and will be capable of augmenting on-site staff with technicians from nearby projects or regional service centers.

The Project has entered into multiple agreements with various support service vendors, including compliance planning, scheduling and settlement services, asset management services, forecasting, and operations and maintenance services. Many of these services will influence final outage scheduling and asset management.

The Project will use industry-standard Supervisory Control and Data Acquisition ("SCADA") system measurement and communications equipment to make information available in real time and enable coordination 24/7 between stakeholders regarding outage scheduling and status through systems integration. This coordination may generally include information as required by pertinent regulatory bodies and customers such as:

- Supplying low-side generator net-MW and MVAR output and other telemetry data
- Supplying meteorological data (wind speed and direction, temperature, pressure, humidity)
- Scheduling the operation and outages of facilities, including providing advanced notification
- Coordinating the synchronization and disconnection of the Project with NYISO, the transmission owner, and others in the power market
- Providing data required to operate the system and conduct system studies
- Providing documented start-up and shutdown procedures, including ramp-up and ramp-down times

Properly scheduled outages for plant maintenance and repairs are essential to overall efficiency and functionality. The Project will enforce standard operating procedures as part of a cross-functional program for outage planning that will coordinate necessary outages across procurement, asset management, operations, and customers. Our goal is to maximize plant availability through efficient coordination of both preventive and corrective maintenance.

Electric Transmission, Gathering, and Interconnect Lines

The Project does not have any overhead transmission lines. The Underground right of way and Junction boxes will be inspected Semi-annually throughout the life of the Project to identify any issues and determine whether the vegetation needs to be cleared or trimmed in the right of way to maintain access and operability as needed. Prior to the inspection, Ball Hill Wind will notify affected property owners advising them that personnel will be on their property for the inspection of the collection line. Additionally, public notice will be posted in the local newspaper, advising the community of the inspection period if work needs to be conducted in the public right of way.

NERC Compliance Plan

A North American Reliability Corporation (“NERC”) compliance program is a critical part of the construction, ownership, and operation of a wind farm connected to the bulk electric system. A wind power generating facility that is registered as a generator owner (“GO”) and a generator operator (“GOP”) is subject to dozens of NERC reliability requirements, with any compliance or documentation failures potentially resulting in monetary penalties against the facility.

As a company with experience bringing utility-scale wind generation to market, NPI is comfortable with the regulatory hurdles necessary to commission and operate a wind power facility.

NPI has considerable experience operating in the NERC region and has utilized this experience to develop NERC procedures for Ball Hill Wind. Also, NPI has made it a priority to select a service provider for the project that has a strong track record of experience with NYISO’s systems and filings.

Training and Notifications

New Ball Hill Wind-affiliated workers at the Project with O&M responsibilities will be provided with a copy of the Final O&M Plan and required to review it and comply with it in combination with their review of other Ball Hill Wind policies and plans such as the Emergency Action Plan and Health and Safety Plan. A copy of the Final O&M Plan and other key plans also will be available at the O&M building. Vestas will have its own plans for their technicians to train on and to abide by.

Beyond new hire orientation, Vestas or any Ball Hill Wind-affiliated worker’s direct supervisor will provide training in accordance with the Final O&M Plan as needed to support the worker’s specific job functions.

If maintenance activities have the potential to result in temporary impacts that may affect the local community (e.g., temporary transportation impacts), notification of such maintenance activities as noted in the an. If work within a public right-of-way is necessary to conduct maintenance in accordance with the O&M Plan, notification and

any necessary work permit(s) will be discussed and obtained from the appropriate agencies prior to starting the work.

Table 1 Automation – Protective relays			
Component attributes		Maximum service interval	Minimum maintenance activities
Any unattended protective relay that does not have all monitoring attributes:		6 years	For all unattended relays: ● check that the settings comply with specifications ¹ . For non-microprocessor relays: ● test and recalibrate if necessary. For microprocessor relays: ● check the operation of relay inputs and outputs which are essential for the proper functioning of the protection system ² . ● verify the acceptable measurement of values input of the electrical network ³ ; ● check the characteristics of the curves and settings ⁴ .
Relay	Function		
distance	21		
Undervoltage	27		
Overcurrent	50 and 51		
overvoltage	59		
directional	67		
differential	87		
frequency	81		
		12 years	Check: ● that the settings comply with specifications ¹ . ● the operation of the relay inputs and outputs which are essential for the proper functioning of the protection system ² . ● the acceptable measurement of the network input values electrical ³ . ● check the characteristics of curves and settings ⁴ .
The above-mentioned protective relays with monitored microprocessors having the following attributes: ● internal self-diagnosis and alarm. ● at least three voltage or current wave sampling per cycle, and digitization of samples for microprocessor calculations. ● power supply failure alarms.			

¹ Verification is done by injection and comparison of settings.

- Ex.: Checksum to check that you have the right version of setting.
- Ex.: Verification of the characteristic showing that the setting is valid.

² Tests of protective relays may be carried out at the producer's end only. The presence of a technician at the other end is not required.

³ The measurement is verified by the relay by injecting currents and/or voltages (e.g., confirmation of phasors). by reading at the relay display). An acceptable phasor value (modulus and argument) is included in the relay measurement tolerances (see relay datasheet). The input values of the network are phase currents (IA, IB, IC) and voltages (e.g., VAN, VBN, VCN).

⁴ Verification of the characteristics of the various curves associated with the protection logic as well as the settings aims to confirm the absence of drift, alteration, or modification of the characteristics.

Table 1 (continued) Automation – Protection relays		
Component attributes	Maximum service interval	Minimum maintenance activities
The monitored microprocessor protective relays with the attributes of the previous line, plus the following: • AC measurements continuously compared to an AC reference • Monitoring some or all the binary or status inputs and control outputs by a means that continuously confirms their correctness operation, with alarm in case of failure. • alarm in case of change of settings.	12 years	Check only unattended relay inputs and outputs that are essential for the proper functioning of the protection system.

Table 2 Automatisms – Circuit breaker trip sequence		
Component attributes	Maximum service interval	Minimum maintenance activities
Contacts of the trigger sequence: • trigger circuits (function 94). • blocking circuits (function 79BL or 86). • cut-off apparatus (function 52).	6 years	Check the correct operation of DC tripping or blocking circuits ⁵ .

Table 3 Automation – Communication Systems		
Component attributes	Maximum service interval	Minimum maintenance activities
Any unattended communication system (function 85) necessary for the proper functioning of the protection functions, and not having all the monitoring attributes.	12 months	Check that the communication system is functional ⁶ .
	6 years	Check that the communication system meets the performance criteria relevant to the communication technology used (signal level, power reflected, bit error rate, etc.). Check the operation of the inputs and outputs of the communication system that are essential for the proper functioning of the protection system.

Table 3 Automation (Continued) – Communication Systems		
Component attributes	Maximum service interval	Minimum maintenance activities
Any communication system (function 85) with continuous monitoring or automated periodic tests for the presence of the channel function, and with loss of function alarm.	12 years	Check that the communication system meets the performance criteria relevant to the communication technology used (signal level, reflected power, bit error rate, etc.). Check the operation of the inputs and outputs of the communication system that are essential for the proper functioning of the protection system.
Any communication system (function 85) with the following attributes: • continuous monitoring or periodic automated testing of channel performance according to criteria relevant to the communication technology used (level signal, reflected power, bit error rate, etc.) and excessive performance degradation alarm. • Monitoring some or all binary or status inputs and control outputs by a means which constantly confirms its proper functioning, with alarm in case of failure.	12 years	Check only unattended entrances and exits from the communication system that are essential for the proper functioning of the protection system.

⁵ The voltage loss simulation on the network side of HOT shall be carried out to ensure the proper functioning of the locking device blocking the closing of the cut-off device in the absence of voltage on the HOT network. For this test, the turbine/generator sets can be separated from the HO network. The trip function test (from the relay to the circuit breaker) can be done with an isolated circuit breaker (open disconnecter). When checking the chain of protective elements, however, the principle of overlap (see definition, Article 2) must be applied.

⁶ The alarm test for remote protection may be carried out by communication break to generate the alarm and by measuring the RX and/or TX communication level in db.

Table 4 Automation – Voltage- or current-sensitive devices providing signals to protective		
Component attributes	Maximum service interval	Minimum maintenance activities
Any voltage- or current-sensitive device that does not have monitoring attributes.	12 years	Check that current and voltage signal values are provided to the protective relay.

Table 5 Automation – AC power supply for battery-equipped protection system station		
Component components	Maximum service interval	Minimum maintenance activities
Batteries that do not have monitoring attributes.	18 months	All types of batteries, check: • the voltage of the charger ac supply. • the maintenance voltage of the battery charger. • the continuity of the batteries. • the resistance of connection to the terminals of the batteries. • the connection resistance between battery cells or between batteries. • the temperature of the batteries by thermography. • the temperature of the room. Inspect: • the electrolyte levels. • the condition of all battery cells if visible or measure the internal ohmic value of the cells or batteries if the elements are not visible. • the condition of the battery shelf. Check: • detection of accidental groundings
	6 months	Recombinant gas lead-acid batteries (VLRA): • measure the internal ohmic value of the batteries⁷.
	3 years	VRLA batteries • verify that substation power batteries have retained their original performance by comparing indicator cell or battery measurements of performance (internal ohmic values, maintenance current, etc.) to Battery Part⁷; OR • verify that the substation power batteries have retained their original performance by performing a modified performance or capacity test for the entire battery group⁷.

⁷ A performance threshold of 80% of maximum battery capacity is considered the minimum acceptable.

Table 5 (continued) Automation – AC power supply for battery-equipped protection system station		
Component attributes	Maximum service interval	Minimum maintenance activities
Batteries that do not have monitoring attributes.	6 years	Batteries other than VLRA: • verify that the substation power batteries have retained their original performance by comparing cell or battery measurements indicative of performance (internal ohmic values, current maintenance, etc.) to battery reference values⁸, OR • verify that substation power banks have retained their original performance by performing a modified performance or capacity test for the entire battery pack

Table 6 Switchgear – Circuit breakers		
Component attributes	Maximum service interval	Minimum maintenance activities
Fittings, insulators and related elements	12 months	Do thermography Check: • visually the general condition of the circuit breaker, structures, and foundations. • visually the grounding fittings. • the level of insulating oil of the circuit breaker and bushings and the presence leaks (if any). • the hydraulic oil level of the control and the presence of leaks (if any). • the position indicator. • the condition of the insulators. • the presence of oil leakage on distribution capacitors (if any). • Check for the pneumatic circuit breaker: • the compressed air system. • the presence of leaks. • the pressure and dew point.

		• the condition of the compressors, tanks, dryer, and ducts.
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Table 6 (continued) Switchgear – Circuit breakers		
Component attributes	Maximum service interval	Minimum maintenance activities
Fittings, insulators and related elements	6 years ⁹	Check: • heating and thermostat setting. • operation of the low temperature alarm at –5 °C (if applicable). • condition of the wiring and lack of loose connection. • oil pressures of the mechanism • (if applicable). • the control mechanism. • the oil level of the opening and closing dampers and the presence of oil leaks (if any). • the operation of the position indicator. • visually signaling contacts (mechanism, contacts, coils), including the absence of corrosion (clean if necessary). • adjustments to oil pressure switches, if necessary, and instruments for SF6. • the operation of the anti-pumping. • the wear of the motor brushes (if applicable). Clean bushings or insulators, if required. Record the pressure of SF6 and refill as needed to the maximum filling pressure as a function of temperature. • Measure the percentage of SF6 of the insulating gas and its moisture content • (according to the manufacturer's specifications). Correct the mixture, if necessary, according to the manufacturer's specifications). • Carry out: • measurement of contact resistance. • timing (with displacement sensors when prescribed by the manufacturer). • AC insulation test

Table 7 Switchgear – Disconnectors

Component attributes	Maximum service interval	Minimum maintenance activities
Fittings, insulators, and related elements Mechanics: blade, jaw, contact	12 months	Make thermography Check: • the general condition of the disconnector, structures, and foundations. • visually the condition of the insulators. • visually the grounding fittings. • the general condition of the interior of the cabinets. • the condition of the breaker coating (if applicable).
	2 years	If the device has not been operated for 2 years: • perform a functional test Check: • if the disconnector is difficult to operate. • if the blade closes well in the jaw (check, if possible, the position of the blade in the jaw). • proper operation when opening and closing; For motorized disconnectors: • check the proper functioning of cams and switches. • measure the operating time.
	6 years	Check: • the correct functioning of the heating circuit. • the correct functioning and adjustments of the operating mechanism. • the attached grounding disconnector (if applicable). Lubricate the mechanism. Measure the contact resistance of the disconnector.

Table 8 Apparatus – Power transformers

Component attributes	Maximum service interval	Minimum maintenance activities
Transformer, main tank, plug changer bowl, radiator, pumps, fans, fittings, cable terminations, shielded bars, cabinets, bushings, oil	12 months	Make thermography: • fittings. • cable terminations, if any. • shielded bars insulated in the air. • heating of cabinets. • temperature difference between the inlet and outlet of the cooling; Oil tests (dissolved gas analysis) - Check: • dissolved gas (ASTM 3612) • water content (ASTM D1533) • visual inspection Check: • the general condition of the transformer and its foundation. • the color of the transformer desiccant and desiccator condition. • if there are oil leaks (bushings, main tank, handling changer tank (if applicable), radiators, valves, and piping. • the oil level on the level indicator of the preservatives, bushings, and load changer (if possible, from the ground). • visually the radiators, pumps, fans. • if radiators are blocked by dirt, bird nests, etc. • the condition of the pressure vent • (sealing), if applicable. • operation of the heating of the control cabinets. • visually the condition of the • visually the grounding fittings; Take the dissolved gas sensor reading (if applicable). Record the temperature of the oil and winding and check the temperature difference between the oil and the winding taking into account the load. Read the CPC transaction counter and ensure its operation (if applicable).

Table 8 (continued) Apparatus – Power transformers

Component attributes	Maximum service interval	Minimum maintenance activities
	12 months	Visually inspect the control box.
Oil, probes, relays, threads, fittings, fuses, junction boxes and shielded bars	6 years	Oil tests (physic-chemical analysis) - Check: • acidity (ASTM D974) • interfacial tension (ASTM D971) • dielectric strength (ASTM D1816, 2mm) • power factor at 100 °C (ASTM D924) • DBPC – antioxidant only Check: • calibration of thermometers oil and winding as well as the proper functioning of the contacts on the mechanical temperature indicators. • the thermal image circuit associated with the winding temperature indicator. • the operation of the gas relay on mechanical temperature indicators. • visually the status of the gas relay thread, temperature indicators and booster relays. • the level oil from the bushings. • visually the pressure relief valve, if applicable. • visually the condition of the fittings, fuses. • the tightness of the junction boxes of the transformers • the general condition of the housing and cabinet of the probes as well as their tightness, if any. Carry out: • visual inspection of shielded bars. • ac insulation test of bushings and windings for transformers 315 kV and less. • DC insulation test of the core and cylinder head presses when connections are accessible externally. • lubrication of motor windings, if applicable. Test AC insulation on 120 kV bushings and above. If in doubt about bushings 120 kV and above, take a sample for dissolved gas measurement and water content (ASTM D-3612).

Table 9 Switchgear – Capacitive voltage transformers		
Component attributes	Maximum service interval	Minimum maintenance activities
Fittings and appliance assembly, structures and foundations, insulators and housings, grounding fittings	12 months	Make thermography Check: • the general condition of the transformer, structures, and foundations. • visually inspect the condition of insulators and housings from the ground. • visually inspect the grounding fittings. • the presence oil leaks. Carry out phase-earth voltage readings and compare the secondary voltages of the devices⁸.
	6 years ⁹	Perform an AC insulation test (10 kV Doble).

⁸ Compare the readings of the 3 phases with each other and ensure that the imbalance between them does not exceed the acceptable limits. A reading that does not meet these thresholds, if it does not result from an inaccuracy of the reading device or the margin of error of the voltage transformer, may be a sign of a TTC degraded with one or more capacitive elements that have become short circuited.

⁹ The minimum maintenance activities prescribed at this interval, for the specified component attributes, are in addition to the activities prescribed at intervals of 12 months mentioned above in this table.

Table 10 Apparatus – Inductive transformers for measurement, current, voltage, unit of measurement excluding air-insulated current transformers (donuts) 15		
Component attributes	Maximum service interval	Minimum maintenance activities
Fittings and appliance assembly	12 months	Do thermography Check: • oil level. • presence of oil leaks. Perform phase-earth voltage readings and compare secondary voltages of devices.
Oil	6 years	If possible, take a sample for the measurement of dissolved gases and water content (oil appliances). Otherwise, perform an AC insulation test Check: • the presence of oil leaks at secondary terminal blocks and expansion cells, if applicable. • the oil level at the indicator or gas pressure, as appropriate. • the right operation of the oil level indicator, if applicable. • the operating pressures of the density meter, when possible, if applicable (SF6 device). • the dew point of the gas. • The percentage of SF6 in the mixture, if applicable (correct the mixture as needed). • visually inspect the status of the bursters on the current transformers, if any.

Table 11 Switchgear and equipment – Capacitor banks		
Component attributes	Maximum service interval	Minimum maintenance activities
Fittings, external fuses and capacitors	12 months	Do thermography – check: • visually inspect the condition of capacitors, fuses, and current limiters. • visually inspect the condition of structures and foundations. Record the phase load current and the imbalance current in the neutral, if accessible

Table 12 Apparatus – Stretch Bar Sets and Guard Wires		
Component attributes	Maximum service interval	Minimum maintenance activities
Equipment in service	12 months	Visually verify physical integrity

Table 13 Apparatus – Surge arresters		
Component attributes	Maximum service interval	Minimum maintenance activities
Equipment in service	12 months	Make the complete thermography of the surge protector Check: • visually inspect the general condition, structures, and foundations. • visually inspect the condition of the grounding fittings.
	6 years	Perform the AC insulation test

Table 14 Apparatus – Lightning rods and guard wires		
Component attributes	Maximum service interval	Minimum maintenance activities
Equipment in service	12 months	Check: • visually the general condition, structures, and foundations. • visually the condition of the fittings and the continuity of the grounding circuits.

Table 15 Generator and its batteries		
Component attributes	Maximum service interval	Minimum maintenance activities
Generator and its batteries	12 months	Check the operation.

Table 16 Additional equipment – (where applicable to POI)		
Component attributes	Maximum service interval	Minimum maintenance activities
AC filters	12 months	Check the general condition; Do thermography.
	6 years	Perform the tuning test.
Static compensators (CLC)	12 months	Check the general condition; Do thermography.
	6 years	Perform the tuning test.
Dynamic VAR Compensator (DVAR)	12 months	Check the general condition; Do thermography; Check the oil level on the indicator or the gas pressure, as appropriate.
	6 years	Perform the tuning test.

Table 17 Civilian elements		
Component attributes	Maximum service interval	Minimum maintenance activities
Land surface (post)	12 months	Verify the integrity of component components, including cladding grading, retaining walls and vegetation control.
Fence and barrier (motorized)	12 months	Verify the integrity of component components, including safe clearances between ground and fence, grounding, barriers, traffic signs, foundations, and mechanical components, and electric.
Lighting and light tower	12 months	Check the lighting and correct accordingly.
Drainage	12 months	Verify the integrity of component components, including ditches, ducts, manholes, sumps, access shafts, containments, culverts and pumping stations.
Pumping station, oil recovery system	12 months	Visually check soils if contaminated, presence of various debris, presence of holes and areas of water accumulation. Visually verify the integrity and proper functioning of the recovery basin and separator
Sanitary installation: pits and sewage treatment work	12 months	Check the integrity of element components, including pre-filters, fleets, alarms, physical protection, and signage.
Control building	12 months	Check the integrity of component components, including hardware, sanitary equipment, protective equipment, access equipment, electrical components, mechanical components (HVAC) and areas storage of hazardous materials.

Table 17 (Continued) Civilian elements		
Component attributes	Maximum service interval	Minimum maintenance activities
Gantry (stop structure) including conductors, poles, guy wires, insulators and related accessories	12 months	Check the integrity of component components, including clearances from plant components (vegetation control).
Cable trays and ducts - transformer station	12 months	Check the integrity of element components, including covers and walls; Check drainage.
Cable trays and ducts - Underground collector network	12 months	Check the integrity of element components, including covers, walls, and fittings; Check drainage.
Overhead lines - transformer station including conductors, poles, guy wires, insulators and related accessories	12 months	Check the integrity of component components, including clearances from plant components (vegetation control)
Overhead lines – Collector system including conductors, poles, guy wires, insulators and related accessories	12 months	Check the integrity of component components, including clearances from plant components (vegetation control)