



Cassadaga Wind Project

Case No. 14-F-0490

1001.6 Exhibit 6

Wind Power Facilities

EXHIBIT 6 WIND POWER FACILITIES

(a) Factors Considered During Placement of Wind Turbines (Setback Requirements/Recommendations/Fall-Down Distances)

The primary goal of wind turbine siting and design is to maximize the capture of wind energy to assure economic viability, while providing a design that minimizes environmental impacts and meets turbine vendor site suitability requirements and local law considerations. As such, this is an iterative process with the final Facility array design reflecting a balance of these factors. The proposed location and spacing of the wind turbines and support facilities is initially based upon site constructability, landowner participation, wind resource assessment, environmental resource factors, proximity to existing transmission and review of the site's zoning constraints. Factors considered during preliminary and final placement of turbines and other Facility components include the following:

- Wind Resource Assessment
- Distance from Residences and Other Buildings, Non-participating Land Parcels, Roads, and Other Infrastructure
- Sufficient Spacing (i.e., avoid turbine wake effects)
- Agricultural Protection Measures
- Biological and Cultural Resources
- Wetland and Stream Resources
- Unusual Landform Areas

As indicated previously, the Facility Site has a rural and low-density character, and high density residential land use is not extensive. One of the primary objectives of developing the Facility layout has been to avoid and/or minimize interaction with sensitive natural resources (e.g., wetlands, streams, forested habitat). More detailed discussion on the Facility's relationship to these features and other resources, such as schools, recreational lands, and historic properties is provided in other sections of this Application. This section of the Application provides an evaluation of the Facility's turbine setbacks.

A setback is the distance which a wind turbine, building, or other structure must be set back from a road, residence, property line, or other location appropriate for a setback. Wind turbine setbacks are designed to prevent turbines from being erected in areas where sensitive resources would be located within a "fall zone" or "fall-down distance," which is the area directly under a wind turbine that could be subject to falling debris in the unlikely event of a blade failure, tower collapse, icing, or other mechanical problems. See Exhibit 15 for additional information about potential

public safety issues associated with wind energy facilities. In order to create a safe “fall-down distance”, setbacks are often based on total turbine height (i.e., the height of the entire turbine, as measured from the tower base at the ground surface to the tip of the blade oriented in its highest position). Therefore, for a turbine whose total turbine height is 500 feet, the “fall-down distance” for that turbine would be 500 feet.

Due to market factors such as availability and cost, a specific turbine model has not yet been selected for the Facility. However, turbine models that have been determined to be suitable for this site include the Gamesa G114 (2.1 MW), Gamesa G114 (2.625 MW), Gamesa G126 (2.5 MW), General Electric (GE) 2.3-117 (2.3 MW), GE 2.75-120 (2.75 MW), GE 3.2-130 (3.2 MW), Nordex N117 (3.0 MW), Siemens SWT-2.3-120 (2.3 MW), Siemens SWT-3.3-130 (3.3 MW), Vestas V112 (3.0 MW), Vestas V117 (3.3 MW), Vestas V126 (3.3 MW), and Vestas V136 (3.45 MW). The total height for these turbine models ranges from 476 to 499 feet. Consequently, a “fall-down distance” of 500 feet accounts for the full range of turbine models under consideration for the proposed Facility and their respective range of heights. Table 6-1 presents the dimensions for each of the alternative turbine models. Please also see Appendix K of this Application for turbine brochures containing additional information about wind turbine technology.

Table 6-1. Approximate Turbine Dimensions by Model

Turbine Model	Rated Power	Hub Height	Rotor Diameter	Total Height
Gamesa G114	2.1 MW	93 meters (305 feet)	114 meters (374 feet)	150 meters (492 feet)
Gamesa G114	2.625 MW	93 meters (305 feet)	114 meters (374 feet)	150 meters (492 feet)
Gamesa G126	2.5 MW	84 meters (276 feet)	126 meters (413 feet)	147 meters (482 feet)
GE 2.3-117	2.3 MW	94 meters (308 feet)	116 meters (381 feet)	152 meters (499 feet)
GE 2.75-120	2.75 MW	85 meters (279 feet)	120 meters (394 feet)	145 meters (476 feet)
GE 3.2-130	3.2 MW	85 meters (279 feet)	130 meters (427 feet)	150 meters (492 feet)
Nordex N117	3.0 MW	91 meters (299 feet)	117 meters (384 feet)	150 meters (492 feet)
Siemens SWT-2.3-120	2.3 MW	92 meters (302 feet)	120 meters (394 feet)	152 meters (499 feet)
Siemens SWT-3.3-130	3.3 MW	85 meters (279 feet)	130 meters (427 feet)	150 meters (492 feet)
Vestas V112	3.0 MW	96 meters (315 feet)	112 meters (367 feet)	152 meters (499 feet)
Vestas V117	3.3 MW	92 meters (302 feet)	117 meters (384 feet)	150 meters (492 feet)

Turbine Model	Rated Power	Hub Height	Rotor Diameter	Total Height
Vestas V126	3.3 MW	87 meters (285 feet)	126 meters (413 feet)	150 meters (492 feet)
Vestas V136	3.45 MW	82 meters (269 feet)	136 meters (446 feet)	150 meters (492 feet)

(1) Manufacturer's Setback Specifications

The Applicant is not aware of any manufacturer's setback specifications for any of the turbine models under consideration for the Facility. Manufacturer's siting guidelines are typically focused on technical issues such as available wind resource at a given site (i.e., on selecting the appropriate technology/ turbine model) rather than on land use/zoning issues such as setbacks.

(2) Applicant's Applied Setbacks

When identifying appropriate setbacks for a given project, the Applicant generally considers the following: a) abiding by any applicable regulations, b) ensuring the safety of the public and neighboring properties by siting turbines away from non-participating property lines, roads, and other public infrastructure at a distance of at least the maximum blade tip height, and c) minimizing impacts at residential or other sensitive structures related to sound or shadow flicker.

The Applicant has applied setback standards for the Facility according to setback requirements set forth in the Towns of Arkwright, Charlotte, and Cherry Creek zoning regulations¹. The Applicant believes that the Towns' setbacks adequately provide for the safety of the public and minimize impacts. However, to account for the trend of increasing turbine heights (taller turbines better optimize the capture of wind resources), the Applicant typically applies variable setbacks, as a function of turbine height, rather than fixed-distance setbacks. Given the range of turbine models and associated heights under consideration (476 to 499 feet), setback distances were calculated for the proposed Facility assuming a total turbine height of 500 feet. The Applicant's setback standards for the proposed Facility are summarized in Table 6-2.

¹ There are no proposed turbine sites in the Town of Stockton; the only Facility components within the Town are the POI substation and part of the overhead generator lead line. There are no applicable setbacks for these components.

Table 6-2. Applicant's Setback Standards for the Proposed Turbines

Feature	Basis for Setback	Setback Distance
Substation	1.5x total turbine height	750 feet
Transmission Line ¹	1.5x total turbine height	750 feet
Gas Well	Total turbine height	500 feet
Public Road	1.1x total turbine height	550 feet
State Land	1.1x total turbine height	550 feet
Non-Residential Structure ²	1.1x total turbine height	550 feet
Non-Participating Residence ³	3x total turbine height	1,500 feet
Participating Residence ³	2x total turbine height	1,000 feet
Non-Participating Parcel	1.1x total turbine height	550 feet
Wetland	100 feet	100 feet

¹This setback applies to larger transmission lines (i.e., 115 kV and greater) and is to be measured from the edge of the right-of-way.

²The Town of Arkwright requires a setback of 1.5x total turbine height setback to existing non-wind turbine structures, which would be 750 feet for a 500-foot turbine. There is only one proposed turbine site (T7) in the Town of Arkwright. Turbine T7 is located approximately 1,730 feet from the closest non-residential structure (i.e., has been sited in compliance with the Town's setback).

³Seasonal residences (i.e., camps/trailers classified as seasonal by Chautauqua County) have been included for the purposes of siting turbines appropriate distances from these structures.

(3) Setbacks Required by Local Law or Ordinance

Zoning jurisdiction within Chautauqua County is at the Town level. The proposed turbines are sited in the Towns of Arkwright, Charlotte, and Cherry Creek, each of which have adopted laws specific to wind energy development. Although the wind energy laws in each Town contain a section called "Setbacks for Wind Energy Conversion Systems," none of these laws establish setback requirements for other Facility components. The following table provides a summary of the required turbine setbacks in each Town where Facility turbines are proposed, as set forth in the respective wind energy laws.

Table 6-3. Turbine Setback Requirements for the Towns of Arkwright, Charlotte, and Cherry Creek

Setback Requirement	Town of Arkwright	Town of Charlotte	Town of Cherry Creek
Site Boundaries ¹	500 feet from all Facility Site boundaries.	500 feet from all Facility Site boundaries.	500 feet from all Facility Site boundaries.
Residences	1,200 feet from residences outside of the Facility site, measured from the exterior of the residence.	1,000 feet from all residences, including those on the Facility site and those not participating in the Facility.	1,000 feet from residences outside of the Facility site, measured from the exterior of the residence.
Public Roads	500 feet.	500 feet.	500 feet.
Other Wind Turbines	NA	1,000 feet.	NA
Wetlands	NA	100 feet from the edge of state identified wetlands. May be adjusted at the discretion of the reviewing body.	100 feet from the edge of state identified wetlands. May be adjusted at the discretion of the reviewing body.
Gas Wells	NA	500 feet from gas wells, unless waived in writing by the property owner.	500 feet from gas wells, unless waived in writing by the property owner and well owner.
Non-Wind Turbine Structure or Aboveground Utility	1.5 times the Total Height of the wind turbines from any existing non-wind turbine structure or any existing aboveground utilities, unless otherwise approved by the Town Board.	NA	NA
Noise Related	Adequate distance from existing residences such that turbines are located outside a L ₉₀ – 50 dBA noise level zone. In the event a turbine emits a steady pure tone, the threshold is reduced to L ₉₀ – 45 dBA.	Adequate distance from existing residences such that turbines are located outside a L ₉₀ – 50 dBA noise level zone. In the event a turbine emits a steady pure tone, the threshold is reduced to L ₉₀ – 45 dBA.	Adequate distance from existing residences such that turbines are located outside a L ₉₀ – 50 dBA noise level zone. In the event a turbine emits a steady pure tone, the threshold is reduced to L ₉₀ – 45 dBA.

¹Site is defined in the local wind energy laws as follows: The parcel(s) of land where the Wind Energy Facility is to be placed. The Site could be publicly or privately owned by an individual or group of individuals controlling single or adjacent properties. Where multiple lots are in joint ownership, the combined lots shall be considered as one for purposes of applying setback requirements. Any property which has a Wind Energy Facility or has entered an agreement for said Facility or a setback agreement and received the required variances shall not be considered off-site. In other words, the Site Boundaries setback applies only to the edges of non-participating parcels, not to the boundary between two different participating parcels.

As indicated above, there are no turbines proposed in the Town of Stockton. However, the POI substation and approximately 0.3 mile of generator lead line are sited in Stockton. There are no setbacks in the Town of Stockton Zoning Code applicable to the POI substation and generator lead line.

Please see Exhibit 31 of this Application for additional information on local laws.

(b) Explanation of the Degree to which the Facility Layout Accommodates Turbine Setbacks

Table 6-3 summarizes the turbine setback requirements set forth in the zoning regulations for the Towns of Arkwright, Charlotte, and Cherry Creek. The Facility as currently proposed will meet or exceed all turbine setback requirements, or written consent will be obtained from affected property owners. For example, turbine site T42 is located within a gas well setback, and the Applicant is obtaining permission from the property owner and well owner to be within that setback.

(c) Third-party Review and Certification of Wind Turbines

Equipment reliability is an important criterion in turbine selection. The Applicant has not made a final determination of the wind model or manufacturer, but is presenting in this Application a range of turbine models determined to be suitable for the Facility. The Applicant may select a turbine model not presented in this Application, provided that the turbine total height and sound power level output of the selected turbine is not greater than those analyzed in this Application. Based on preliminary evaluations, 2.1 to 3.45 MW represent the range of turbine size types suitable for this Facility. Turbine models are independently certified as meeting international design standards by independent product safety certification organizations such as Germanischer Lloyd and Underwriters Laboratories. These certifications require that the wind turbines have a design life of at least 20 years for the specified wind regime. The wind regime considers factors such as weather extremes, average wind speed, wind gusts, and turbulence intensity. The third-party certification for one of the turbines under consideration for the Facility is being submitted concurrently with this Application, but under seal due to the confidential nature of this document. The Applicant will ultimately select a turbine that has achieved the necessary third-party certification, and proposes to submit this information to the Siting Board as a post-Certification compliance filing.

(d) Wind Meteorological Analyses

Wind resource analyses were performed in order to optimize the turbine layout for maximum energy production within the context of the existing, site-specific constraints. During the course of the wind analysis, micro-scale wind modeling tools WAsP (www.wasp.dk) and WindSim CFD (Computational Fluid Dynamics - www.windsim.com) were utilized in order to develop the energy yield analysis for the Facility layout. The WAsP model is a linear flow model that was used to determine the resultant wind regime at all turbine positions given data from on-site meteorological

towers and high-resolution terrain from a digital elevation model. Two temporary meteorological towers were erected at the Facility Site to generate the site-specific data necessary for modeling purposes. A preliminary turbine layout was then devised utilizing the resulting wind resource map from the WAsP model. The WindSim CFD model is a more advanced wind flow model and was used to validate WAsP model results in areas of more complex terrain within the Facility site. WindSim was also used to maximize turbine efficiency utilizing multiple turbine wake models in order to determine the most production turbine array due to wake loss. The turbine layout presented in this Application was determined by correlating the most energetic layouts with the most constructible and logistically economical designs, while also factoring in siting constraints and impact avoidance measures.

The detailed results of these analyses are proprietary and are typically retained as trade secrets. Therefore, a copy of the wind meteorological analysis is not being provided with this Application, but rather will be provided to DPS under separate cover. The Applicant is seeking the requisite trade secret protection for this information pursuant to NY Public Officer's Law Section 87(2)(d) and 16 NYCRR 6-1.4.

Publicly available wind resource maps suggest a suitable wind resource along ridgetops at the Facility Site (AWS Truewind, 2007; NREL & AWS Truepower, 2010). The Cassadaga Wind Project will have a nameplate capacity of up to 126 MW, and is expected to operate at an annual net capacity factor of approximately 36%. This means that over the course of a full calendar year the Project would produce up to 397,353 megawatt hours (MWh) of energy (i.e., 126 MW x 24 hrs/day x 365 days x 36%). This is enough electricity to meet the average annual consumption of between approximately 36,422 and 55,915 households, based on the average annual electric consumption of 10.9 MWh for the U.S. and 7.1 MWh for New York State, respectively (USEIA, 2015).

REFERENCES

AWS Truewind. 2007. *Wind Resource of New York: Mean Annual Wind Speed at 100 Meters*.

National Renewable Energy Laboratory (NREL) and AWS Truepower. *New York Annual Average Wind Speed at 80 m*. November 2, 2010.

U.S. Energy Information Administration (USEIA). 2015. *Electric Sales, Revenue, and Average Price: 2014 Average Monthly Bill – Residential*. Data from Forms EIA-864 schedules 4A-D, EIA-861S, and EIA-861U. Available at: http://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf (Accessed February 2016).