THE STATE OF NEW HAMPSHIRE

SITE EVALUATION COMMITTEE

Docket No. 2015–02

APPLICATION OF ANTRIM WIND ENERGY, LLC
FOR A CERTIFICATE OF SITE AND FACILITY

APPLICANT'S RESPONSES TO SITE EVALUATION COMMITTEE DATA REQUEST

Date Request Received: September 29, 2016 Date of Response: November 7, 2016

Request No.: Committee 2-1 Witness: Siemens

REQUEST: What is the threshold for determining if enough light exists to cause shadow flicker?

Response: Siemens will provide AWE with a shadow flicker control system ("SFCS") to ensure that shadow flicker does not exceed the SEC's 8-hour per year shadow flicker limit. The SFCS will consist of a programmable logic controller ("PLC") and sensors installed on each turbine. The PLC will be programmed with the turbine locations and the locations of nearby residences where shadow flicker could exceed the 8-hour limit without any operational controls. With the geographic location of each turbine, all applicable receptors, and the location of the sun in the sky during all times of the year, the PLC will determine if there is a direct line between sun, rotor and residence. A direct line must exist for any shadow flicker to be possible. If these conditions do exist, then the PLC will determine whether the applicable turbine is operating. Finally, the sensors will detect whether the light conditions are such that a perceptible shadow may be cast. If all of the conditions are present, then the PLC will shut down the applicable turbine or turbines if they would contribute to any shadow flicker in excess of the limit until such conditions no longer exist.

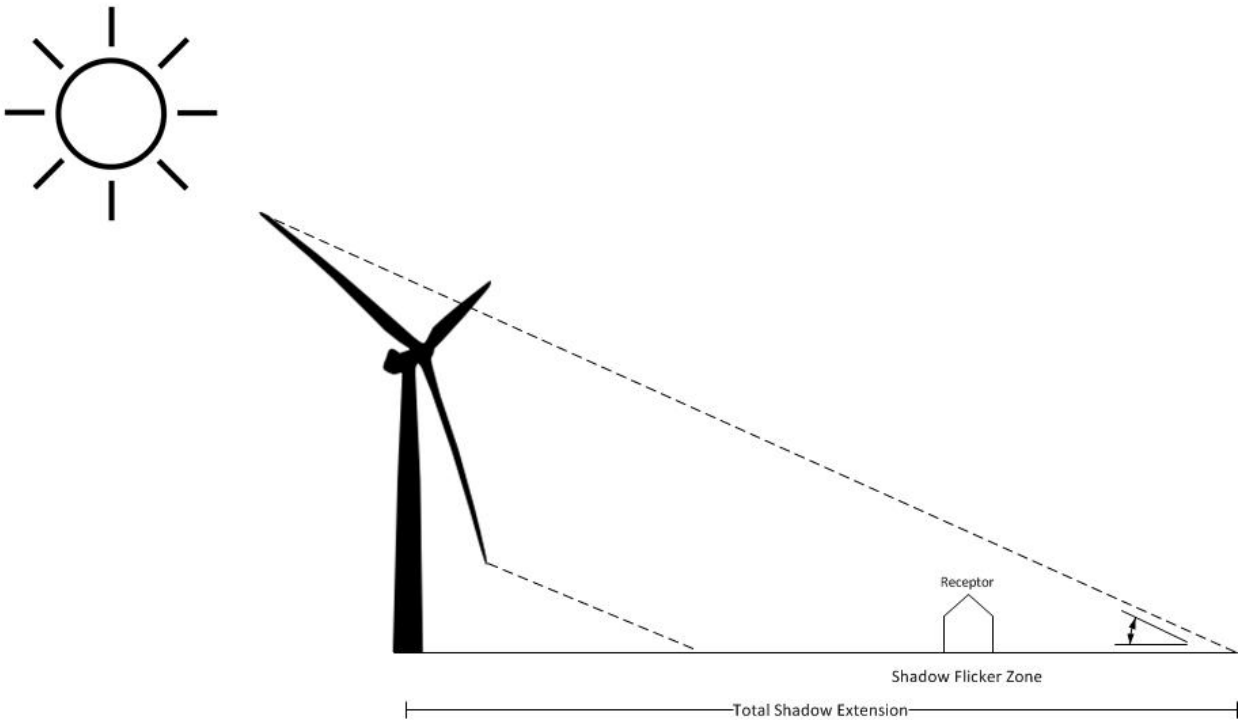

Figure 1 - Shadow Flicker Representation on a Receptor

For a shadow to be perceptible, there must be both luminance, and a contrast between the illuminated surface and the portion of the surface that the shadow falls on. Thus, there are two elements to the light-sensing component of the SFCS. First, the minimum luminance that would create the conditions for a perceptible shadow is 323 lux, which is approximately the equivalent of low light conditions at sunrise and sunset (Leibowitz, 1987). Second, contrast is a property of how much of the ambient light comes directly from the sun versus how much light is being radiated by other features in the sky (Frazor & Geisler, 2006), and is calculated by analyzing various atmospheric conditions. The SFCS will use measures of sky luminance, sun luminance and solar elevation to calculate contrast in relation to each receptor. The contrast threshold is 10% (Smedley, Webb & Wilkins, 2010). Flicker ceases to be provocative at luminance contrasts less than 10% (Harding, Harding & Wilkins, 2008)[1].

All threshold settings will be validated and tuned at the site under various conditions during the commissioning of the Siemens wind turbines, and continuously monitored for data validity and health of operation during the systems' lifetime.

For each of the applicable receptors, the SFCS shall maintain a log of the number of hours and minutes of shadow flicker each received during the applicable year, as well as any hours during which any WTGs were shut down to prevent shadow flicker at each receptor from exceeding 8 hours per year, if any. The SFCS shall be capable of producing an annual report containing such information, which shall be made available to the Committee and the Town.

[1] Some of the best research into luminance contrast levels comes from medical research related to epilepsy. The research provides a very conservative level for addressing all disturbances related to shadow flicker. It is important to note that photosensitive epilepsy is not triggered by flicker at frequencies less than 2.5 Hz and the maximum frequency of potential flicker from a SWT-3.2-113 turbine is 0.825 Hz.

The SFCS shall commence measuring shadow flicker on the final commissioning date and shall continue until the first anniversary of such date and on the first anniversary of such date and each anniversary thereafter, the log shall reset with respect to the 8-hour annual limit.

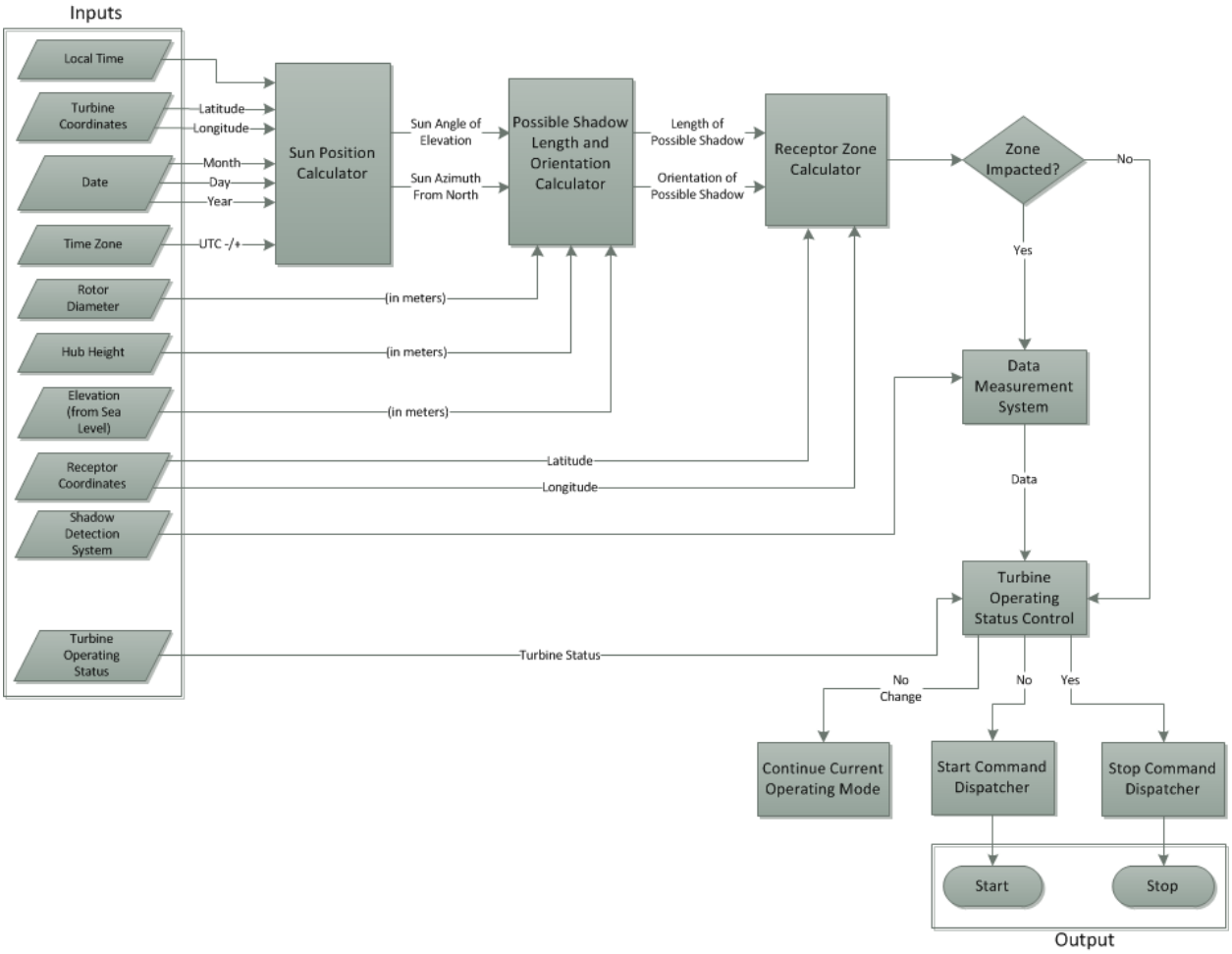

Figure 2 - Control System Overview

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Date Request Received: September 29, 2016 Date of Response: November 7, 2016

Request No.: Committee 2-2 Witness: Siemens

REQUEST: How often will the sensors be cleaned?

Response: The system continuously self-monitors for data validity and sensor health. If the sensors are obstructed (dirt, ice, bird nests, etc.) the system will alarm. This alarm will then trigger inspection and maintenance.

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Date Request Received: September 29, 2016 Date of Response: November 7, 2016

Request No.: Committee 2-3 Witness: Siemens

REQUEST: How often will the sensors be calibrated?

Response: The sensors will be calibrated the earlier of every three years or in accordance with the sensor manufacturer's recommendations.

Works Cited:

Frazor, R. A., & Geisler, W. S. (2006). Local luminance and contrast in natural images. Vision Research, 1585–1598.

Leibowitz, H. W. (1987). Ambient illuminance during twilight and from the moon. Night Vision Current Research and Future Directions (pp. 19-22). Washington D.C.: National Academy Press.

Smedley, A. R., Webb, A. R., & Wilkins, A. J. (2010). Potential of wind turbines to elicit seizures under various meteorological conditions. Elipsia Official Journal of the International League Against Epilepsy, 1146-1151.

Harding, G., Harding, P., & Wilkins A. (2008). Wind turbines, flicker and photosensitive epilepsy: Characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them. Elipsia Official Journal of the International League Against Epilepsy, 1095-1098.