STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

Petition of Cassadaga Wind LLC for Amendment of the Certificate of Environmental Compatibility & Public Need

Case No. 14-F-0490

PETITION OF CASSADAGA WIND LLC FOR AN AMENDMENT TO THE CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY & PUBLIC NEED FOR THE CASSADAGA WIND PROJECT

Dated: November 20, 2020
Albany, New York

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I. INTRODUCTION

On January 17, 2018, the Siting Board issued an Order granting a Certificate of Environmental Compatibility and Public Need, with Conditions ("Certificate") to Cassadaga Wind LLC ("Cassadaga Wind" or "Certificate Holder"). Cassadaga Wind has submitted the requisite compliance and informational filings required by the Certificate Conditions to commence construction and is in the process of compiling the requisite compliance and informational filings required to commence commercial operations. The Certificate authorizes construction of 48 wind turbines to be located in the Towns of Cherry Creek, Charlotte, and Arkwright, capable of producing up to 126 megawatts ("MW") (referred to herein as the "Facility") of electricity.

Relevant to this Petition, the Certificate includes sound limits in Certificate Condition 80. Condition 80 requires the Facility to comply with both short-term sound limits (45 dBA Leq-8-hour at non participating and 55 dBA Leq-8-hour at participating residences) and long-term annual sound limits (40 dBA L_{night} outside non-participating residences and 50 dBA L_{night} outside at participating residences). These limits require post construction sound monitoring to confirm the Facility is in compliance with the limits per Certificate Conditions 71 and 72.

Pursuant to 16 NYCRR § 1000.16, Cassadaga Wind respectfully requests an amendment to the Certificate to eliminate the long-term annual sound limits in Certificate Condition 80(b). Certificate Condition 80(b) requires that the Facility "[c]omply with a limit of 40 dBA L(night-outside), annual equivalent continuous average nighttime sound level from the Facility outside any existing permanent or seasonal non-participating residence, and a limit of 50 dBA L(night-outside), annual equivalent continuous average nighttime sound level from the Facility outside any existing participating residence."[1] Since the Siting Board issued the Cassadaga Wind Certificate

[1] Certificate at p. 35.

on January 17, 2018, the Siting Board has not required annual sound limits for any other wind project.[2] Cassadaga Wind is requesting that the Siting Board amend the Certificate to remove the annual sound limit from Cassadaga Wind's Certificate as explained further below. In addition, Cassadaga Wind requests that the Siting Board adopt Cassadaga Wind's Sound Monitoring and Compliance Protocol for short-term compliance testing prepared by the Resource Systems Group, Inc. ("RSG"). Attached as **Exhibit A** and **Exhibit B** to this Petition is testimony from Kenneth Kaliski, Senior Director with RSG and Sylvia Broneske, the Principal Acoustics Engineer for RWE Renewables which support why the annual sound limit should be removed from the Certificate.

The Amendment of the Certificate to remove the annual sound limit will not have a significant adverse impact on the environment and therefore, this Petition should not be considered a "revision" but instead should be considered a "modification" of the Certificate. The amendment would not increase any environmental impacts and would make the Cassadaga Wind Certificate conditions on sound consistent with all other Article 10 Certificates issued to date. As such, this amendment can be authorized by the Siting Board or Commission pursuant to 16 NYCRR 1000.16 for modifications. Under 1000.16, no hearing is required for modifications to a Certificate. After a 30-day public comment period, the Siting Board/Commission can render a decision.

II. OVERVIEW

Cassadaga Wind is the first large-scale renewable wind facility approved by the Siting Board and issued an Article 10 Certificate. The sound design goals and regulatory sound limits were litigated and the parties' positions were part of the record before the Siting Board when it

[2] Application of Eight Point Wind, Case No. 16-F-0062; Application of Baron Winds, Case No. 15-F-0122; Application of Number Three Wind, Case No. 16-F-0328; Application of Bluestone Wind, Case No. 16-F-0599; and Application of Canisteo Wind, Case No. 16-F-0205; Application of Alle-Catt Wind, 17-F-0282; Application of Atlantic Wind LLC, Case No. 16-F-0267.

issued the Certificate. However, no Party advocated for an annual regulatory sound limit in the proceeding, and the Recommended Decision ("RD") did not recommend any annual regulatory sound limits. Notwithstanding, the Siting Board found "it necessary to apply a longer-term standard consistent with NARUC [National Association of Regulatory Utility Commissioners] of 40 dBA $L_{90\text{-}10\ minute}$ standard as a long term multi week average" and added Condition 80(b) to the Certificate Conditions.[3] Notably, Condition 80(b) of the Certificate is 40 dBA $L_{night,}$ not 40 dBA $L_{90\text{-}10\ minute}$. With this finding, to the best of Cassadaga Wind's knowledge, Cassadaga Wind became the only wind energy facility in the ***world*** with an annual regulatory sound requirement. As no Party advocated for an annual sound limit and the RD did not recommend an annual regulatory limit, the issue of applying such a standard was not fully briefed or explored in the record, and therefore the Siting Board was likely unaware of the implications of such a condition.

Subsequent to the issuance of the Cassadaga Wind Certificate, other Article 10 applicants have had the opportunity to present evidence to the Siting Board on the practical implications of requiring an annual regulatory limit like the one required by Cassadaga Wind's Certificate. None of the seven Certificates issued after Cassadaga Wind require the annual regulatory sound limit.

a) <u>Necessity of Modification</u>

As recognized in the Baron Wind's Order[4], no standard exists for measuring wind turbine sound as an average sound level for a year. Moreover, the basis stated by the Board for the annual regulatory limit is to minimize the potential for annoyance to and complaints of nearby residents. However, an annual regulatory standard has little effect on annoyance and complaints which are

[3] Case No. 14-F-0490 "Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions for Cassadaga Wind LLC," issued January 17, 2018, p. 70.
[4] The Certificate Holder Baron Winds, LLC is affiliated with Cassadaga Wind LLC and their parent company RWE.

generally related to short-term sound events lasting minutes or hours, not years.[5] Thus, the annual sound limit does not address the potential claimed impact nor minimize the potential for annoyance and complaints.

Short-term regulatory sound limits are the standard method of regulating wind facilities across the world[6], and indeed Cassadaga Wind's Certificate has short-term sound limits in its Certificate. The short-term limits in the Cassadaga Wind Certificate (Condition 80(a)) make certain that sound impacts from the Facility will be avoided or minimized to the maximum extent practicable. Moreover, Cassadaga Wind has designed the project to meet a long-term design goal of 40 dBA $L_{(night\text{-}outside)}$ at night at non-participating homes. The short-term enforceable and measurable sound limits along with the long-term design goal of the Facility ensure sound impacts have been avoided or minimized. There is no need for an additional annual regulatory limit to address impacts, especially because demonstrating compliance with such a limit through post construction monitoring is difficult and uncertain, as set forth in detail in the testimonies of Kenneth Kaliski and Sylvia Broneske, and has never been required at any other wind facility in the state—or for that matter, the globe.

As described in detail in the accompanying testimony of Kenneth Kaliski and Sylvia Broneske, accurately monitoring sound emissions from wind turbines over the course of a year can be extremely difficult, time consuming and costly.[7] Sound emissions from wind turbines are constantly changing due to changes in wind speed and direction, and changing propagation characteristics such as temperature, humidity, and atmospheric pressure. An accurate annual

[5] Case 15-F-0122 "Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions for Baron Winds LLC," issued September 12, 2019, p. 120.
[6] *See* Case No. 15-F-0122 Application of Baron Winds LLC for a Certificate of Environmental Compatibility and Public Need, "Applicant's Post-Hearing Initial Brief" submitted April 16, 2019.
[7] *See* Case No. 15-F-0122 Application of Baron Winds LLC for a Certificate of Environmental Compatibility and Public Need, "Applicant's Post-Hearing Initial Brief" submitted April 16, 2019.

sound level measurement from a wind turbine would require a significantly long-term sound monitoring campaign to determine the annual average because weather conditions vary over the year. Moreover, an accurate sound monitoring campaign necessarily involves shutting down turbines to assess turbine only sound levels. Broneske estimates the long-term monitoring protocol would cost between $150,000 to $312,000 to implement depending on the extensiveness of the monitoring conducted. However, this is not the full cost of the monitoring as Kaliski estimates that at least 112 shutdowns would be necessary to implement the monitoring, resulting in both, economic loss due to turbines not operating, as well as the loss of generating potential of renewable energy.[8]

RSG and RWE's internal sound experts, have studied, modeled, and monitored wind farms for over a decade, and are unaware of any jurisdiction in the world implementing an annual regulatory limit requiring long-term monitoring.[9]

Long-term monitoring is also impractical to enforce. Even if the first year of compliance tests were able to accurately demonstrate that the Facility was not in compliance with the annual limit, it could take years of additional compliance tests to demonstrate that measures have brought the Facility into compliance. Noise complaints at wind projects are usually related to certain time periods and weather conditions, all short-term events. Moreover, it is unlikely that Department of Public Service staff would be able to undertake a long-term monitoring campaign to confirm the Applicant's monitoring results, which by its nature requires at least weeks – if not months – of monitoring time. Additionally, responding to a complaint regarding "annual or longer-term" sound is impractical. Presumably, responding to such a complaint would take months to a year, and then validating whether mitigation or other measures were effective if a violation has occurred

[8] *Id.*
[9] *Id.*

could take another year. In theory, it could be years before a complaint allegedly relating to an annual sound condition is ever resolved.

The difficulty with creating a monitoring program to measure annual sound impacts is demonstrated in the attached testimony. Neither DPS Staff, RWE Renewables, nor RSG, who has extensive expertise in measurement of wind turbine sound and has published work in accredited scientific journals, have ever developed, implemented, or tested a long-term monitoring campaign like the one required for Cassadaga Wind. Again, Cassadaga Wind is the only wind energy facility in the world with an annual regulatory sound requirement.

Despite the complexities with creating a long-term monitoring protocol, in an effort to comply with the Certificate, on February 26, 2018, Cassadaga Wind submitted a Sound Monitoring and Compliance Protocol to DPS Staff for review. This protocol addressed issues identified in the Certificate Order, including adding a protocol for the annual regulatory limit consistent with NARUC's (National Association of Regulatory Utility Commissioners) long term multi week average monitoring methodology given the Siting Board's reference to NARUC's "longer-term" guidance[10]. DPS Staff objected to the use of the NARUC methodology and proposed a method based on ISO 9613-2 or CONCAWE meteorological categories with a "turn-on turn-off" approach to measuring background sound levels.

Cassadaga Wind accepted DPS Staff's comment to use CONCAWE sound propagation meteorological categories with turbine-on turbine-off testing and filed the Cassadaga Wind Sound Monitoring and Compliance Protocol with the Secretary to the Commission on April 17, 2018 ("April Protocol"). Compliance with DPS Staff's suggestion required the Protocol to be changed

[10] Case No. 14-F-0490 "Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions for Cassadaga Wind LLC," issued January 17, 2018, p. 70.

to propose measurements under representative meteorological conditions and wind turbine shutdowns to assess background sound levels.

Cassadaga submitted the Protocol within 90 days of the Certificate Order as required by Certificate Condition 71. The Protocol was prepared by RSG and was consistent with the provisions and procedures for postconstruction sound performance evaluation indicated in the Application Protocol with edits to specifically address regulatory conditions of the Certificate, including the long-term monitoring requirement which had not previously been proposed to be included in the proceeding. However, DPS Staff indicated to Cassadaga Wind that they had new comments on the Protocol. Cassadaga and DPS staff have met several times since April 2018 to discuss the comments and finalize the protocol but have been unsuccessful in reaching a resolution in over two years. Much of the disagreement between Cassadaga Wind and DPS Staff involves the long-term monitoring provisions. Therefore, RSG has revised the April 2018 protocol to remove the long-term monitoring and is filing the new proposed protocol with this Petition. The revised April 2018 protocol submitted along with Kenneth Kaliski's testimony, should be approved by the Siting Board. Even if DPS Staff and Cassadaga Wind could agree on a long-term protocol, it would be experimental at best and costly and time consuming to implement, all for uncertain results, given that annual noise limits and annual monitoring are not suitable for wind farm sound.

In the meantime, the Siting Board has issued another seven Article 10 Certificates to other wind facilities, including Baron Winds. In each of these proceedings the Siting Board has intentionally declined to require a annual sound limit. In the Baron Winds proceeding, the Siting Board specifically held "there is no need to impose a long-term regulatory limit" and "a long-term

regulatory limit would be impractical to enforce."[11] The Siting Board's Orders in the other Article 10 proceedings confirms that this requirement should be removed from Cassadaga Wind's Certificate.

b) <u>Impact Analysis</u>

To determine whether a proposed amendment is a modification or a revision, 1000.16(a) states that the criteria for determining significance under 6 NYCRR 617.7(c) shall apply. This criterion includes "a substantial adverse change in existing air quality, ground or surface water quality or quantity, traffic or noise levels".[12] The elimination of the annual regulatory sound limit will not result in a substantial adverse change in noise levels, as the Facility will still be required to comply with the short-term sound levels and the Facility will still be designed to meet the annual sound levels. The elimination of the annual enforceable regulatory sound limits will not increase environmental impacts, at all. The Siting Board has held that a short-term limit of 45 dBA Leq-8-hour at non participating and 55 dBA Leq-8-hour at participating residences, and the long-term design goals of 40 dBA L_{night} outside and 50 dBA L_{night} outside at non-participating and participating residences is adequately protective of human health.[13] There is no need for an annual enforceable regulatory sound limit in addition to these standards. None of the criteria in 617(c) will be triggered by the Amendment. Accordingly, the Amendment is not a "revision" and the procedures applicable to modifications shall apply.

[11] Case 15-F-0122 "Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions for Baron Winds LLC," issued September 12, 2019, pp. 122-123.
[12] 6 NYCRR 617.7(c)(1)(i)
[13] Case 16-F-0559 "Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions for Bluestone Wind, LCC," issued December 16, 2019, p. 55.

III. CONCLUSION

Requiring Cassadaga Wind to comply with an annual regulatory standard is inconsistent with every other Article 10 Certificate and every other operating wind facility in the world. It is impracticable, unrealistic, time consuming and costly, and does little to minimize impacts. Therefore, Cassadaga Wind respectfully requests that the Certificate be modified to eliminate Condition 80(b) and that the Siting Board adopt Cassadaga Wind's Sound Monitoring and Compliance Protocol as submitted along with Kenneth Kaliski's testimony.

Dated: November 20, 2020

Respectfully submitted,

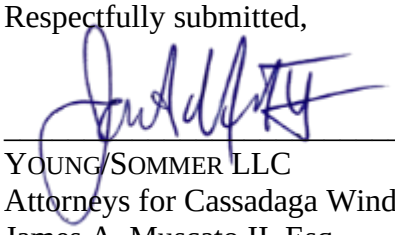

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Exhibit A

NEW YORK STATE BOARD ON ELECTRIC
GENERATION SITING AND THE ENVIRONMENT

Case No. 14-F-0490	Application of Cassadaga Wind LLC for an Amendment of its Certificate of Environmental Compatibility and Public Need to Construct a Major Electric Generating Facility in the Towns of Charlotte, Cherry Creek, Stockton, and Arkwright, New York

TESTIMONY OF:

KENNETH KALISKI, SENIOR DIRECTOR

RSG

Q: Please state your name, employer, and business address.

A: Kenneth Kaliski, RSG, 55 Railroad Row, White River Junction, VT 05001.

Q: Please describe your background and professional experience.

A: I am a senior director with Resource Systems Group, Inc. ("RSG"). I have been employed by RSG for 34 years. I am a licensed professional engineer in the states of Vermont, New Hampshire, Michigan, Massachusetts, and Illinois. I am Board Certified through the Institute of Noise Control Engineering ("INCE") and formally served on INCE's Board of Directors and as Vice President of Board Certification. Within INCE I am currently the co-chairman of the Wind Turbine Technical Activity Committee and a member of the Certification Board. I am also a member of the Acoustical Society of America and serve on its Noise Technical Activity Committee. In 2020, I won the INCE William W. Lang Distinguished Noise Control Engineer award for my "… notable contributions to the field of wind turbine acoustics, and use of rigorous analytics and novel approaches to advance the field of noise control engineering."[1] I am also principal author of the National Academies of Sciences, Engineering, and Medicine's National Cooperative Highway Research Report, 882, "How Weather Affects the Noise you Hear from Highways" (2018). This two-year study researched how meteorology changes the propagation of sound from roads. My resume is attached as **Exhibit "A".**

[1] Quotation from the award citation.

Q: Have you appeared in this proceeding before?

A: RSG is the acoustics consultant for Cassadaga Wind LLC and I have previously personally appeared in this proceeding including providing written and oral testimony. All of Cassadaga Wind's Sound Monitoring and Compliance Protocols have been prepared under my direction and control and I am familiar with the facts and circumstances surrounding this proceeding.

Q: What is the purpose of your testimony?

A: I am submitting this testimony in support of Cassadaga Wind's Petition to amend its Article 10 Certificate of Environmental Compatibility and Public Need (the "Certificate") to eliminate the annual sound limit in Condition 80(b) and adopt Cassadaga Wind's Sound Monitoring and Compliance Protocol attached as **"Exhibit B"** ("Final Protocol").

Q: What does Condition 80(b) require?

A: Certificate Condition 80(b) requires that the Facility "[c]omply with a limit of 40 dBA L(night-outside), annual equivalent continuous average nighttime sound level from the Facility outside any existing permanent or seasonal non-participating residence, and a limit of 50 dBA L(night-outside), annual equivalent continuous average nighttime sound level from the Facility outside any existing participating residence."

Q: Are you aware of any other wind projects with a condition like 80(b)?

A: I have been involved in modeling and monitoring sound from wind projects since 1993. I am actively involved in research involving wind turbine noise and have written more than a dozen publications on the subject. To the best of my knowledge, Cassadaga Wind is the only wind farm in the world with a requirement like Condition 80(b), an annual regulatory limit necessitating long-term monitoring to demonstrate compliance.

Q: Is there any standard for measuring wind turbine sound for an annual average?

A: No standard exists for measuring wind turbine sound for an annual average as required by Cassadaga's Certificate.

Q: Why should Condition 80(b) be eliminated from Cassadaga's Certificate?

Accurately monitoring sound levels from a wind farm over the course of a year would be extremely difficult, time consuming and costly as well as of questionable accuracy.

- Sound emissions from wind turbines are constantly changing due to variations in wind speed.
- Sound propagation characteristics are constantly changing due to variations in wind profile (which includes the effects of changing wind speed and wind direction by height above ground), temperature lapse rate, turbulence, temperature, humidity, and atmospheric pressure.

- An accurate annual sound level measurement from a wind turbine would require a significantly long sound monitoring campaign to determine the annual average because these weather conditions vary hour by hour over the year and thus monitoring would need to be conducted under many different representative meteorological conditions.
- The results will likely be biased high due to problems measuring wind turbine sound below the background sound level. Any sound level measurement conducted at a residence near an operating wind power project, will include sound from both the wind power project and other background sound present in the area (cars, plants, animals, insects, wind-induced, aircraft, yard maintenance, etc.). To assess turbine-only sound levels, contribution from these other sources needs to be removed. When measuring relatively loud sounds that are well above background, such as roads or airports, these sources can often be neglected, but due to the relatively low overall sound levels produced by wind turbines, this is particularly critical since any of these background sources can produce sound levels that are at least as high as turbine sound. Thus, to accurately measure background sound, all wind turbines within about 1.5 miles of the monitor location are shutdown for a period to allow for measurement of the contribution from these other sources. This method only works if contributions from background sources are below the wind turbine sound

level. Thus, taking measurements during periods with low turbine sound emissions may not be possible. This is usually not a problem with short-term noise limits, as we are focused only on the highest sound levels. But when monitoring for an annual average, we need to accurately monitor all turbine sound levels – high and low.

As a result, it is my expert opinion, that long-term compliance monitoring is an excessive and unreasonable request.

Q: What would sound monitoring for an annual average involve?

Our most current estimate is that there are 60 unique combinations of meteorological conditions that need be represented over the course of a year at the Project. These represent 10 ranges of wind speeds affecting sound emissions from the wind turbines and six sound propagation classes. For the greatest accuracy, all of these conditions would have to be measured.

In a wind turbine sound monitoring campaign, the best way to calculate the wind turbine sound level, is to set out a monitor to collect both wind turbine and background sound. Then, the Project Operator would periodically shut down the wind turbines so that only the background sound is measured. We then subtract the background sound from the total sound level in the hour before and after the shutdown. This yields two hours of turbine-only sound levels for each shutdown.

To obtain the range of meteorological conditions necessary to calculate an annual average sound level, the wind turbines would have to be shut down at least 112

times over at least two seasons (for example, leaf on and leaf off, or spring and fall). Since the occurrence of any particular propagation class is very difficult to forecast in advance, we would consider it necessary to conduct four wind turbine shutdowns at regular intervals per day, over 14 days and two seasons (4 times per day X 14 days X 2 seasons = 112 shutdowns). More shutdowns may be necessary if certain meteorological categories are not represented during the first round of testing.

Q: Do you have concerns about how accurate the results would be?

In addition to the time and cost of setting out long term monitors and shutting down wind turbines, there are issues with the accuracy and bias of the methodology. In particular, the problem lies with the fact that the existing background sound levels are very similar to the Certificate long term noise standard of 40 dBA Lnight. Preconstruction sound monitoring at Cassadaga found that the existing average nighttime sound level ranged from 37 dBA in remote rural areas to 40 dBA in rural agricultural areas of the Project (Cassadaga Wind Preconstruction Noise Impact Assessment, May 21, 2016). However, for a measurement of the wind turbines to be valid, their sound must be greater than the background sound level (ANSI S12.9 Part 3). Thus, for rural agricultural monitoring stations, on average, only turbine sound levels that are greater than 40 dBA would be validly measured.[2] For all other times, the wind turbine sound is less than 40 dBA, the data must be declared invalid.

[2] Actual hourly background sound levels will vary, but the average is 40 dBA.

If the only valid data is 40 dBA or above, the average will be greater than the annual standard of 40 dBA. Thus, the protocol is by design biased to eliminate low wind turbine sound levels from the calculation of an annual average since those are the only levels that are likely to be possible to measure and almost guarantees a violation of the standard where none exists.

Q: What about enforcing long-term monitoring?

A: Long-term monitoring is impractical to enforce, and it is unlikely that DPS Staff will be able to independently confirm compliance with the annual limit due to the complexity and cost of the monitoring protocol. Moreover, if compliance tests were able to accurately demonstrate that the Facility was not in compliance with the annual limit, it would then require another year of additional compliance tests to demonstrate that minimization measures have brought the Facility into compliance. Thus, the time required between complaint and resolution of the complaint is, from the perspectives of the complainant, regulator, and project operator, frustratingly slow.

Complaints related to sound and annoyance are often caused by short-term noise events. An annual regulatory limit is not likely to avoid or minimize impacts beyond those avoided or minimized by the short-term limits already required.

Even if the annoyance is due to annual sound, this annoyance is captured by measuring compliance with the short-term limit of 45 dBA L_{8h}. A recent study found that annoyance to wind turbine sound is somewhat correlated with the short-

term sound level (L_{1h}), but not correlated with an adjustment made to represent the long-term average sound level (Haac et al, 2019).[3]

Q: Did Cassadaga Wind attempt to develop a protocol for the annual regulatory limit?

A: Yes. On February 26, 2018, Cassadaga Wind submitted a draft of its Sound Monitoring and Compliance Protocol to the Department of Public Service ("DPS") Staff for review. This protocol addressed issues identified in the Certificate Order, including adding RSG's proposed protocol for the annual regulatory limit.

Despite the difficulties with implementing a long-term monitoring campaign, in an effort to comply with the Siting Board's Order, RSG added to the Board-approved short-term protocol a long-term protocol consistent with NARUC's (National Association of Regulatory Utility Commissioners) long term multi week average monitoring methodology ("Draft Compliance Protocol").

The NARUC methodology in the Draft Compliance Protocol does not require wind turbine shutdowns to calculate background sound levels. Instead, the background would be based on a proxy location placed outside the Cassadaga wind turbine soundscape. Assuming this proxy location had background levels that correlated with the measurement locations within the wind farm, they could be matched hour by hour.

[3] Annoyance was found to be mostly correlated with subjective factors rather than objective sound levels.

Q: Are their drawbacks with the NARUC methodology?

A: This methodology has several drawbacks. First, there is uncertainly around the correlation of background sound levels for locations that are miles apart. As an extreme example, if someone is mowing their lawn next to the wind farm monitor but not the proxy background monitor, the calculated turbine only sound level would be inaccurately high. In part, we addressed that uncertainty by proposing to conduct a round of monitoring prior to the start of operations at the proxy to determine whether the proxy location was correlated to the subject monitoring location. However, there is no way to completely eliminate the natural variability in background sound that exists between two locations that are one or more miles apart. In addition, NARUC, to some extent, addresses that uncertainty, by eliminating the top five percent of calculated wind turbine sound levels. However, DPS Staff disagrees with this approach.

Furthermore, if the turbine sound level does not exceed the background sound level, then the turbine-only sound level is indeterminate, and that hour is not included in the long-term average. Thus, the method biases the long-term average high.

Q: Did DPS Staff review the protocol?

A: On March 15, 2018, DPS and Cassadaga Wind met to review the Draft Compliance Protocol. On April 12, 2018, following up to the March 15 meeting, DPS provided Cassadaga Wind with comments to the protocol. In their comments, DPS found issue with the NARUC-based method, primarily because the NARUC method

calculates a long term mean metric rather than the L_{night} metric, and proposed a method based on ISO 9613-2 or CONCAWE meteorological categories with a wind turbine "turn-on turn-off" approach to measuring background sound levels.

Cassadaga Wind incorporated the DPS Staff's proposal to use ISO 9613-2 or CONCAWE sound propagation meteorological categories with turbine-on turbine-off testing into the Cassadaga Wind Sound Monitoring and Compliance Protocol and filed it with the Secretary to the Commission on April 17, 2018 ("April Protocol"). This Protocol changed the method of long-term monitoring to one whereby measurements would be made under representative meteorological conditions and background sound levels measured using wind turbine shutdowns.

In this version of the protocol (dated April 13, 2018), RSG proposed a method based on CONCAWE meteorological categories. This method has not been implemented at an operating wind farm to our knowledge, but theoretically would measure background and thus turbine-only sound levels more precisely than the NARUC method.

Q: Did DPS have any further comments on the April Protocol?

A: After the filing of the April Protocol, DPS Staff informed Cassadaga Wind that they still had comments on the April Protocol. In DPS's comments, they considered it too complicated and they recommend another method that eliminated consideration of several meteorological conditions. To the best of my knowledge neither DPS nor

the Siting Board or Public Service Commission have approved the April Protocol that was filed on April 17, 2018.

Q: Did Cassadaga Wind and RSG attempt to revise the April Protocol to address DPS Staff's comments?

On June 29, 2018 Cassadaga Wind and RSG again met with DPS Staff to discuss the April Protocol. Based on comments received from DPS staff on June 29, 2018 the April Protocol was revised further, and several changes were made to address DPS Staff comments. The further revised protocol was submitted to DPS for review again on August 13, 2018.

Q: Were Cassadaga Wind and DPS ever able to agree on a protocol?

A: No. After subsequent meetings with DPS staff in November 2018, the Protocol was further revised to address additional DPS comments, adding details to the methodology and examples on how the methodology is implemented. Cassadaga and DPS staff have met several times since November 2018 to discuss whether a resolution can be reached regarding the remainder of DPS Staff's comments but have been unsuccessful in reaching a resolution in over two years. Much of the disagreement between Cassadaga Wind and DPS Staff involves the long-term monitoring provisions.

Q: What are Cassadaga Wind's concerns with DPS Staff comments?

A: As outlined above, one of Cassadaga Wind's major concerns with DPS Staff's comments on the Protocol, and any long-term protocol that attempts to accurately

predict annual sound levels, involves the number of shutdowns required to accurately measure long term sound levels, and taking measurements during periods with low turbine sound emissions may not be possible. DPS and RSG disagree on how to handle situations where measurements cannot be made in representative meteorological conditions that represent low wind turbine sound levels.

DPS has proposed a variety of different methods for the monitoring the annual sound level limits either as part of comment's on RSG's protocol or as part of the protocol proposed by DPS in the Baron Winds case, that was ultimately rejected by the Siting Board. These methods have attempted to simplify RSG's method. Unfortunately, DPS's measures do not ensure that turbine-only sound measurements are obtained for all relevant operational conditions. This will lead to inaccurate results. In particular, DPS's suggestions bias the sound levels high by eliminating periods when wind turbine sound levels are low or too low to accurately measure.

Overall, the disagreements between DPS Staff and Cassadaga Wind demonstrates the difficulties with implementing a long-term monitoring campaign and highlights why no other wind facility in the world has such a requirement. Even if DPS Staff and Cassadaga Wind could agree on a long-term protocol, it would be experimental, costly and time consuming to implement, all for uncertain results.

For all the reasons I have stated above, I support Cassadaga Wind's Petition to remove the annual regulatory limit from the Certificate. Short-term regulatory sound limits are the standard method of regulating wind facilities and the short-term limits in the Certificate ensure that sound impacts from the Facility will be avoided or minimized to the maximum extent practicable, as the Siting Board has found in every other Article 10 proceeding to date.

I also support Cassadaga's request that the Siting Board adopt Cassadaga Wind's Sound Monitoring and Compliance Protocol attached as "Exhibit B". ("Final Protocol").

Q: Does the Final Protocol address other aspects of the Order required to be addressed by the Certificate?

A: Yes. Cassadaga submitted a Sound Testing Compliance and Noise Complaint Protocol with its Article 10 Application ("Application Protocol"). (Exhibit KK-7; Hearing Ex. 23) Certificate Condition 71 of Cassadaga's Certificate requires that Cassadaga Wind submit "a Sound Testing Compliance and Noise Complaint Protocol" and states that "[c]ompliance with Certificate Conditions for the Facility shall be evaluated by the Certificate Holders by following a Sound Testing Compliance and Noise Complaint Protocol that shall…Follow the provisions and procedures for post-construction noise performance evaluations indicated in the *Application*…" (Condition 71, emphasis added).

Based on the Board's decision in the Order, two specific issues needed to be addressed in the Application Protocol: 1) to incorporate the new regulatory noise standards proposed by the Board, which are limited to amplitude modulation complaint response, vibration complaint response, low-frequency octave band sound levels, and annual average sound levels, and 2) to allow for DPS to choose up to three monitoring locations. In all other aspects the Application Protocol was approved by the Board's Order.

Therefore, based on the Siting Board's Order and this Petition RSG has updated the Application Protocol to incorporate the regulatory noise standards proposed by the Board, as related to amplitude modulation complaint response, vibration complaint response, low-and frequency octave band sound levels and 2) to allow for DPS to choose up to three monitoring locations.

In addition, the Final Protocol addresses comments received from DPS in March 2018 and omits the monitoring protocol for the long-term annual average sound levels but in all other aspects is the same as the Application Protocol approved by the Board's Order.

Q: Has RSG reviewed DPS Staff's recently developed Sound Testing Compliance Protocol in other proceedings?

RSG understands the DPS Staff has recently developed a Sound Testing Compliance Protocol and RSG has reviewed DPS Staff's protocol from the Deer River Wind Energy Project (Case No. 16-F-0267)("DPS Protocol"). RSG has a

number of concerns with this new DPS Protocol, the protocol is internally inconsistent, and some equipment specifications and requirements are unrealistic and/or unnecessary.

In particular, we have the following major concerns with the Deer River protocol:

a. The protocol is internally inconsistent. For example, in one part, it requires four days of monitoring with 2 hours in the am, evening, and pm, but compliance is specified as taking eight *consecutive* hours of data.

b. The protocol would be very expensive to implement as attended monitoring, because it requires forecasted worst-case conditions for two hours in the am, pm, and evening on four separate days (plus, apparently eight consecutive hours). So, one would have to field trained staff to at least six sites (no max sites stated), and hope that you get the maximum conditions throughout the day and night, and repeat this four times. In practice, these worst-case conditions are hard to forecast and often do not last for a consecutive eight hours.

c. There is no provision for unattended monitoring or the filtering of unattended data; even though this protocol is best implemented through unattended monitoring.

d. Some equipment specifications and requirements are unrealistic and/or unnecessary.

e. DPS requires the addition of 1.5 dB when measuring sound representative of a two-story home. DPS has admitted that this correction is not needed for Cassadaga Wind. (See DPS Staff Initial Brief, Case 18-F-0262 pg. 16). For this reason alone DPS Staff's short term protocol should not be implemented here.

f. There is no limit on the number of monitoring locations DPS can require.

DPS's Deer River protocol was written by staff who, to my knowledge, have never done compliance monitoring for sound at a wind farm and do not understand the complexities and subtleties in doing so. In contrast, the sound monitoring protocols that are proposed by RSG and the protocol approved by the Board in Baron Winds are written by experts in the field of wind turbine acoustics. The protocols are reflective of our practical experience in wind turbine sound measurements.

Q: Does this conclude your testimony?

A: Yes.

Exhibit A
to Kaliski Testimony

RSG
the science of insight

KENNETH KALISKI, PE, INCE BD. CERT.

Senior Director

Ken Kaliski has 35 years of experience, having worked in all of RSG's market areas with a focus on engineering and advanced analytics. His technical specialty is in noise control engineering, where he works on projects such as community noise monitoring and modeling, architectural acoustics, transportation noise, and industrial noise control. He also works on complex modeling projects in the fields of market and energy research. Ken is the co-holder of Patent 7,092,853 for an Environmental Noise Monitoring System.

EXPERIENCE

35 years

EDUCATION

BE, Engineering, Thayer School of Engineering, Dartmouth College (2002)

AB, Biological Sciences and Environmental Studies, Dartmouth College (1985)

PROJECT EXPERIENCE

Cassadaga Wind – Project manager for a comprehensive noise impact assessment of the Cassadaga Wind project in western New York. The project included seasonal sound monitoring at six sites, background infrasound monitoring, short- and long-term sound propagation modeling, construction noise modeling, and evaluations of annoyance potential using the Community Noise Rating and published dose-response curves. Designed mitigation to meet project design goals, town standards, and proposed regulatory limits. Prepared prefilled testimony and attended New York State Article 10 hearings on the project.

National Survey of Attitudes of Wind Power Project Neighbors – Project manager for a study of the of the factors that affect audibility and annoyance from wind turbines. This study is based on a national survey of people or live around wind power projects, which was conducted by the Lawrence Berkeley National Laboratory and funded by the U.S. Department of Energy. The result of the study was published as a peer-reviewed paper in the Journal of the Acoustical Society of America (see publications, below).

Black Fork Wind – Conducted a noise assessment of this 100.5 MW wind project in Richland and Crawford Counties in Ohio. Monitored background sound levels over a two-week period for eight locations over an eight-day period. Correlated wind speed measured at project met towers with background wind speeds and assessed the average background sound level over all sites for use in comparing modeled wind turbine sound levels to Ohio's relative sound standard. Presented testimony to Ohio Power Siting Board.

Massachusetts Research Study on Wind Turbine Acoustics – Leading a study on wind turbine sound to help the State of Massachusetts Clean Energy Center and

Kenneth.Kaliski@rsginc.com

Department of Environmental Protection improve the regulation of wind turbines in the State. The study includes detailed data collection around five wind projects in New England, support to the Wind Turbine Technical Advisor Committee of the MassDEP, and quantitative analysis of factors such as infrasound, amplitude modulation, sound levels, and sound propagation modeling.

Highland Plantation Wind Farm – Managed the noise study for the Highland Plantation Wind Farm near Bingham, Maine. The project included long-term sound monitoring at five locations around the site and modeling the 39 turbines proposed for the project. Sound propagation modeling was done to assess conformance with the Maine DEP standards, and mitigation was recommended in a report as part of the permitting proceedings.

Scioto Ridge/Hardin Wind – Managed the pre-construction noise study for the 242 MW Scioto Ridge/Hardin Wind project in Hardin and Logan Counties, Ohio. Oversaw the installation of 13 sound monitors around the project and modeling of sound at all residences around the project from construction, the operating wind turbines, and associated transmission line and substation. Prepared direct testimony for the project for consideration at the Ohio Public Siting Board.

Spruce Mountain Wind, Maine – Conducted assessment of turbulence intensity and potential impacts to amplitude modulation during permitting. During post-construction, management of continuous 24/7/365 compliance monitoring system. Developed software for processing combining 50 ms sound monitoring data with turbine SCADA and met tower instrumentation to assess sound pressure level, amplitude modulation, and tonal sound over 10-minute compliance periods.

Review of Wind Project on Behalf of Oakfield Township – Retained by the Oakfield Township in Maine, reviewed the noise portion of the application of First Wind to construct a wind farm. Provided presentations to the Township on general noise topics and, separately, on the findings of our review. Consulted to the Wind Energy Committee on language for a proposed ordinance.

Deerfield Wind Farm, VT – Prepared a noise study for Vermont's Section 248 filing on a 34 MW wind power project proposed for southern Vermont. The project included background sound monitoring, sound propagation modeling of the wind turbines and substation, and preparation of reports and exhibits. Sound modeling included analyses of 8760 hours of meteorology. A report was prepared and testimony was presented to the Section 248 Board

Kingdom Community Wind – Prepared a noise assessment of a 63 MW wind project in Lowell, Vermont. The project included background sound monitoring at six locations, detailed sound modeling to assessment annualized impacts, testimony before the Public Service Board, and post-construction sound monitoring.

PUBLICATIONS

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Kaliski, K., Bastasch, M., and O'Neal, R., "Regulating and predicting wind turbine sound in the U.S.," Proceedings of Inter-Noise 2018, Chicago, Il, August 2018.

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Park, L, Lawson, S, Kaliski, K., Newman, P. and Gibson, A. “Modeling and Mapping Hiker’s Exposure to Transportation Noise in Rocky Mountain National Park,” *Park Science* Vol. 26 No 3, Winter 2009-2010.

Kaliski, K. and Duncan, E. “Propagation modeling Parameters for Wind Power Projects,” *Sound & Vibration Magazine*, Vol. 24 no. 12, December 2008.

Duncan, E. and Kaliski, K. “Improving Sound Propagation Modeling for Wind Turbines,” *Acoustics 08*, Paris 2008.

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Kaliski, K., and Duncan, E. “Propagation Modeling Parameters for Wind Turbines,” *Proceedings of the 2007 Institute of Noise Control Engineers NOISECON* 2007.

Collier, R. and Kaliski, K. “A Low-Complexity Environmental Noise Monitoring System for Unattended Operation in Remote Locations,” Presented at the *Acoustical Society of America conference*, Salt Lake City, 2007.

Hathaway, K, and Kaliski, K. “Assessing Wind Turbines using Relative Noise Standards,” *Proceedings of the 2006 Institute of Noise Control Engineers INTERNOISE* 2006.

PRESENTATIONS

Haac, T., Kaliski, K., Landis, M., and Hoen, B., "Predicting audibility of and annoyance to wind power project sounds using modeling sound," Webinar, Lawrence Berkeley National Laboratory, 2018.

Haac, T, Landis, M., Kaliski, K., Hoen, B., Rand, J., Firestone, J., Pohl, J., Heubner, G., Elliot, D., "Public acceptance of wind energy: Impact of sound levels," Acoustical Society of American, 2018.

Kaliski, K., Lozupone, D., McPhee, P., O'Neal, R., Zimmerman, J., Wilson, K., Rowan-West, C., "The MassCEC Wind Turbine Noise Research Project – Research Goals and Preliminary Results," Acoustical Society of America, Indianapolis, 2014.

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Kaliski, K., Neeraj, G. "Prevalence of complaints related to wind turbine noise in northern New England," 21st International Congress on Acoustics, Montreal, 2013.

Kaliski, K., "Winning Community Acceptance: Dispelling Myths and Promoting the Realities about Wind Power – Noise Impacts," AWEA New England Regional Wind Energy Summit, 2012, and AWEA Community Wind Working Group webinar, 2012.

Kaliski, K., "Topics in Public Acceptance, Human Impacts: Sounds and Shadow Flicker," New England Wind Energy Education Project Conference *Wind Energy in New England: Understanding the Issues Affecting Public Acceptance*, 2011.

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Kaliski, K. "Sound Advice: Evaluating Noise Impacts in a Changing Landscape," American Wind Energy Association Windpower 2009 Conference and Exposition 2009.

Kaliski, K. "Calibrating Sound Propagation Models for Wind Power Projects," *State of the Art in Wind Siting Seminar*, October 2009, National Wind Coordinating Collaborative.

LICENSES, CERTIFICATIONS, MEMBERSHIPS, AWARDS, AND AFFILIATIONS

- Licensed Professional Engineer (PE), States of VT, NH, MA, IL, and MI
- Board Certified, Institute of Noise Control Engineering (INCE)
- William W. Land Distinguished Noise Control Engineer Award (INCE)
- INCE Certification Board
- Co-Chair Wind Turbine Noise Technical Activity Committee (INCE)
- Acoustical Society of America
- Tau Beta Pi Engineering Society

Exhibit B
to Kaliski Testimony

CASSADAGA WIND SOUND MONITORING AND COMPLIANCE PROTOCOL

RSG
the science of insight

11.4.2020

PREPARED FOR:
CASSADAGA WIND, LLC

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CONTENTS

1.0 INTRODUCTION

This is a postconstruction sound monitoring protocol for the Cassadaga Wind Facility. It covers the methodology for post-construction compliance testing and complaint response.[1] This protocol is based on the certificate conditions of the *Order Granting Certificate of Environmental Compatibility and Public Need, Conditions* for Cassadaga Wind LLC (Case 14-F-0490), issued by the New York State Board on Electric Generation Siting and the Environment, hereinafter referred to as the Certificate.

- **Condition 70** places limits on the sound power level of the selected turbine and requires sound modeling of the selected turbine to meet specified design goals.
- **Condition 71** requires that a Sound Testing Compliance and Noise Complaint protocol be established and outlines the contents of that protocol.
- **Condition 72** details the minimum number of compliance tests and the timing of those tests.
- **Condition 73** of the Certificate details the steps that must be taken if the Facility is found to be out of compliance with the Certificate Conditions on noise.
- **Condition 80** specifies the noise and vibration limits from the Facility.
- **Condition 81** outlines the procedures for handling, responding to, and reporting noise and vibration complaints.
- **Condition 82** requires the Certificate Holder to log or keep a record of turbine operating conditions.
- **Condition 83** details conditions relating to construction noise and vibration.

[1] A previous postconstruction sound monitoring protocol was developed to determine compliance with the Certificate conditions proposed by the Applicant. This postconstruction sound monitoring protocol contains revisions to determine compliance with the final Certificate conditions.

2.0 FIRST-YEAR SOUND MONITORING PROTOCOL

The protocol is enumerated as follows:

2.1 | LOCATIONS

There will be three categories of sound monitoring locations as described here:

1) Four locations selected from the preconstruction monitoring locations. These are listed in Table 1, and shown in Figure 1, below. Of these, Nelson Road, Pickup Hill, and Boutwell Hill are adjacent to homes.

TABLE 1: PRECONSTRUCTION MONITORING LOCATIONS USED FOR POST-CONSTRUCTION SOUND MONITORING

Location	Distance to closet wind turbine (ft)	Modeled Sound Level (dBA)
Nelson Road	2,540	41[2]
Pickup Hill	2,389	44
Boutwell Hill	2,824	39
Wooded Area	4,153	38

2) Three additional sound monitoring locations will be identified by DPS staff within 30 days of commencement on construction. The applicant may contest these locations with the Commission as specified in the Certificate and the Article 10 regulations.
3) Up to three additional sound monitoring locations will be identified for monitoring, representing areas where complaints were received during the first full year of operation. If more than three locations received complaints, then three will be selected based on the modeled sound levels of each location and how well a site can represent other complaint locations. Consideration of whether monitoring will be done at a location will also be based on
   a) The type of complaint (amplitude modulation, infrasound, low frequency sound, excessive sound, unusual sound character, outdoor vs indoor, tones, rumbles, rattles, or vibration),
   b) Whether the complaint was due to a continuing operational issue or a non-recurring event,
   c) Whether the modeled sound level is above 40 dBA (see Section 3.6, below), and
   d) Whether the landowner cooperates with the study.

[2] This is a participating location

The Facility is responsible for contacting owners of monitoring sites and obtaining permission to access property to the purpose of sound monitoring. If permission is not granted, then

a) If the site is one of the four pre-construction monitoring sites from Table 1, then an attempt will be made to move the sound level meter to an appropriate location nearby but not limited to an adjacent private property or public space (such as a road), at conditions that are representative of the location that it is intended to be tested.
b) If the site is a DPS-selected site, then the DPS may choose an alternative site, including but not limited to an adjacent private property or public space (such as a road), at conditions that are representative of the location that it is intended to be tested.
c) If the site is from a complaint, then the site will be dropped.

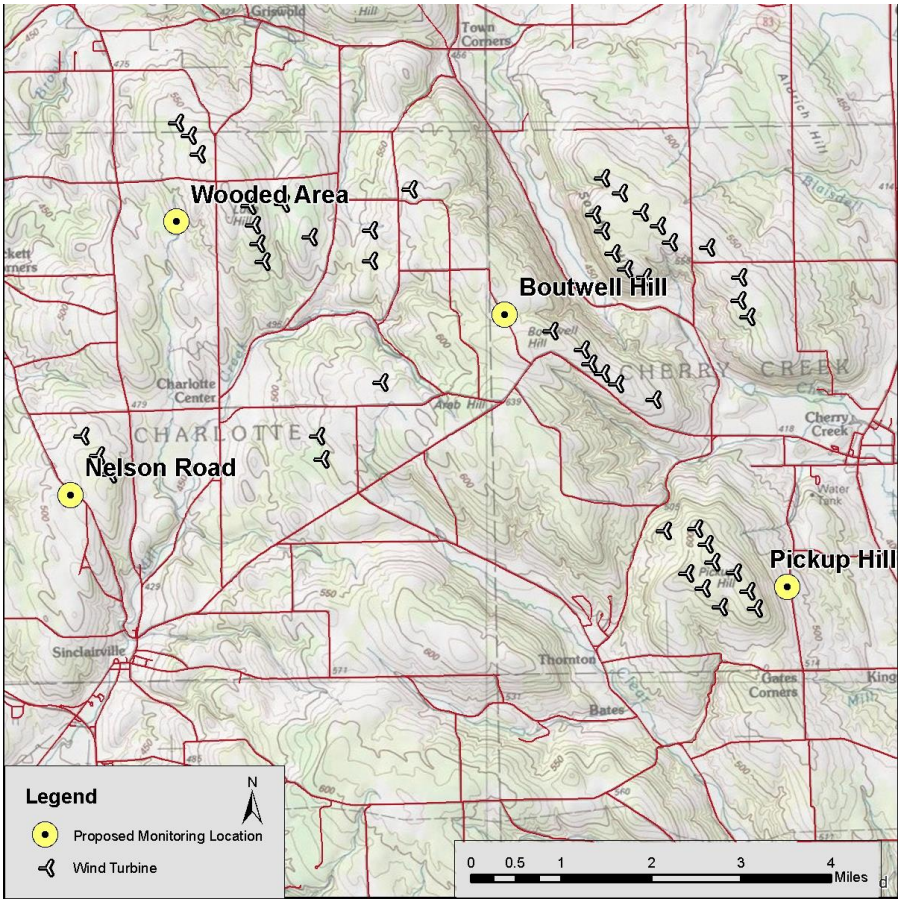

FIGURE 1: MAP OF PRE-CONSTRUCTION MONITORING LOCATIONS FOR CASSADAGA

2.2 | OPERATIONAL SOUND MONITORING TIMING

Once the Facility has commenced operations, operational sound testing will begin.

1) At least two sound level monitoring periods will take place within the first 13 months of facility operation.
2) One of the two must be a "leaf-off" season and the other a "leaf-on" season. Each of these must be at least two weeks long (total elapsed time). Nothing in this protocol precludes additional monitoring at other times of the year.
3) At least one sound level monitoring period will be completed within the first seven months of operation.
4) A second monitoring period will be completed within 13 months after the commencement of Facility operations.

These periods will be reported in two separate compliance reports, the first summarizing the first season of monitoring and the second summarizing the second summarizing all seasons. Sound level limits will be assessed in both reports.

2.3 | SOUND INSTRUMENTATION SPECIFICATION AND CALIBRATION REQUIREMENTS

Each monitoring station shall meet the following criteria:

1) Sound level meters shall be certified to meet the Type 1 or Type 2 accuracy requirements as specified in ANSI S1.4-and IEC 61672-1.
2) Sound level meter microphones shall be placed in accordance with the following criteria. If, at a given site, any of these criteria interfere with the others, they shall take precedence in the order listed:
    a. The microphone shall be fitted with a hydrophobic windscreen of diameter 7 inches (180 mm).
    b. The microphone shall be placed outside, approximately 1.5 meters (4.9 feet) above the ground.
    c. The microphone shall not be placed such that any structure blocks the line of sight between the microphone and otherwise visible wind turbines.
    d. The microphone location at each site will be placed near the residence (if applicable), but no closer than 7 meters (23 feet) to the nearest reflective surface facing wind turbines, such as the wall of a building, to the extent practical.
    e. The microphone shall be located in such a way that it is representative of the noise exposure at the monitoring location.
3) Each sound level meter shall be field calibrated immediately before and after each monitoring period, and during any battery checks. Any calibration drift will be noted.
4) Each sound level meter will have been laboratory calibrated within the two years prior to the monitoring period and each calibrator will have been laboratory calibrated within the year prior to the monitoring period.
5) When an anemometer is included as part of a monitoring station, it will be placed at approximately the same height as that of the microphone at that location.

2.4 | EQUIPMENT SETTINGS

The following equipment settings will be incorporated:[3]

1) Sound levels and spectra as one-second equivalent continuous sound levels will be logged over the entire monitoring period. These include
    a. A-weighted sound levels
    b. 1/3-octave band sound level spectra from, at a minimum, 12.5 Hz to 10,000 Hz
2) Anemometers will log at no more than one-minute intervals and include average wind speed and maximum wind gust for each interval.
3) Additional supporting data to be logged during the monitoring period shall include:
    a. Temperature and rainfall data during the monitoring period, either measured at the site (in 10-minute intervals), or from meteorological data reported from the Chautauqua County airport (station KJHW), substituted as a proxy.
    b. Wind speed and wind direction as measured at each turbine nacelle within 1.5 miles of each monitoring location, logged at 10-minute intervals.
    c. Power output at each turbine logged at 10-minute intervals.
    d. NRO schedule for each turbine, if any.

2.5 | BACKGROUND MEASUREMENTS

To calculate the background sound levels, periodic wind turbine shutdowns will be used. The shutdowns will take place on the following schedule:

1) The sound monitoring period will last at least two weeks or until at least four clean shutdowns have occurred, whichever is later. A clean shutdown is one where the maximum 10-minute hub height wind speed of the closest turbine exceeds a wind speed at which the turbine operates within 1 dB of its maximum rated sound powers and there is no rain for the time between one hour before the shutdown and one hour after the shutdown. For each shutdown, all wind turbines within 1.5 miles of each monitoring station shall be shut down for no less than 10 minutes.
2) Shutdowns will take place every six to eight hours over the monitoring period, except during precipitation in the form of rain, sleet, or hail, or ambient temperatures outside the specified limits of the monitoring equipment.
3) Short-term background sound levels shall be determined using turbine shutdown periods.
    a. The sound levels measured during the periods one hour prior to and one hour following each shutdown period shall be designated as "Turbine-plus-background" sound levels at each monitoring location.[4]

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[3] This section refers to the intervals for the logging of data by the instruments. Reporting will be done at the same or longer intervals such as 10-minute and/or 1-hour.

[4] According to RSG et al, "Massachusetts Study on Wind Turbine Acoustics," 2016, sound levels can be elevated for a few minutes when wind turbines start up after a manual shutdown. Therefore, the

b. The sound levels measured during the shutdown period shall be designated as "Background."
c. If the average wind speed during the Background period is greater than 1 m/s different from the Turbine-plus-background period, then the results will either be excluded, or adjustments for background levels to account for changing wind speed may be used.

2.6 | CALCULATING THE TURBINE-ONLY SOUND LEVEL

The data resulting from the monitoring period shall be analyzed to determine the turbine-only sound level for each period.

1) For both Background and Turbine-plus-background monitoring periods, data shall be excluded from analysis if any of the following conditions occurs:
    a. The presence of contaminating sound caused by human or other activity;
    b. Ground level wind gust speeds exceeding 5 m/s or creating notable contaminating noise;
    c. Ambient temperatures outside the specified limits of the monitoring equipment;
    d. Precipitation in the form of rain, sleet, or hail.
    e. Humidity outside the monitoring equipment specifications.
2) Periods for which data must be excluded for a given station can be determined by one or more of the following methods:
    a. Examining (listening to) the station's audio recordings;
    b. Analyzing the spectrograms of logged sound levels;
    c. Applying data from the meteorological instrumentation.
3) Data that are contaminated by high-frequency sound emitted by insects, birds, and amphibians, may be low-pass filtered using an "ANS" weighting.[5]
4) Background will be subtracted to determine the sound level attributable to the Facility (Turbine-only level).
    a. The Background level is the adjusted Background L_{eq} with a factor added for uncertainty according to ANSI S12.9 Part 3 Clause 7.3.
    b. The sound level attributed to turbine operations shall be determined by subtracting, on an energy basis, the Background from the Turbine-plus-background level, by 1/3 octave band.
    c. Background sound levels determined by subtraction for a given shutdown period shall be considered of sufficient accuracy only if the Turbine-plus-background sound level exceeds the Background sound level by at least 3 dB.

Turbine-plus-background period after the turbine shutdown will start five to ten minutes after all turbines have restarted to allow time to return to normal operation.

[5] "American National Standard Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas", American National Standards Institute ANSI/ASA S12.100, Acoustical Society of America, (2014).

5) If appropriate, audio recordings of the sound and other data will be examined to determine whether the wind turbines contributed to the sound received at the station.
6) 1/3-octave band $L_{eq(10\ min)}$ will be evaluated to identify periods with steady pure tones using the criteria of ANSI S12.9 Part 4 Annex C.
    a. Tonal periods will be further screened to determine if the tonal sound is audible and if so, originated from the wind turbines.
    b. Wind turbine tonal periods will be identified along with the tonal frequency.
    c. If the identified period is tonal, a 5 dB penalty will be added to the turbine-only sound level.
7) For any period where the overall turbine-only A-weighted broadband sound level cannot be calculated due to elevated background sound or where the turbine was operating but not rotating (i.e. low wind speeds), the turbine-only sound level will be assigned a value of -99 dBA.

2.7 | ASSESSING SHORT-TERM STANDARDS

To determine compliance with the 8-hour L_{eq} standard, the equivalent continuous average of eight consecutive hourly L_{eq} measurements will be calculated, on a rolling hourly basis. The resulting $L_{(8h)}$ will be compared to the appropriate regulatory limits in the Certificate.

To assess compliance with individual octave band sound limits, the highest measured hourly turbine-only L_{eq} for each octave will be used.[6]

To determine compliance with the noise standards of the Towns' wind ordinances, the maximum hourly turbine-only L_{10} (corrected for background using the background L_{eq}) will be compared to the appropriate regulatory limits.

2.8 | REPORTING

Cassadaga Wind shall submit the first report no later than eight months after the commercial operations date specifying whether or not the Facility is found in compliance with all applicable Certificate Conditions on noise during the first season of monitoring. The second report for the remaining season will be made available no later than 13 months after the Facility commences operations.

The reports will contain:

1) The locations of all sound monitors and the distance from each to the nearest turbine;
2) A summary of all data collected, including sound levels, calculated turbine-only sound levels, meteorological data at the monitoring stations, and turbine operating conditions[7];

[6] Tonal penalties do not apply to octave band sound limits.
[7] Some portions of the report may include information proprietary to the turbine operator, in which case distribution of that information would be limited per an appropriate protective agreement.

3) A list of periods with Turbine-only sound levels greater than any applicable regulatory limit specified in the Certificate. Details of the analyses of each of those periods will be provided.
4) A list of periods with Turbine-only sound levels greater than an applicable Town noise standard. Compliance with Town standards is based on the hourly L_{10} metric, which will use the short-term turbine-only sound levels around the turbine-shutdown events.
5) An Appendix listing sound levels around each shutdown and the nacelle wind speed and power output for each turbine in 10-minute intervals around the turbine shutdowns during the monitoring period.

The raw data collected at any monitoring station will be made available in electronic form upon request.[8] However, audio recordings from those stations will not be made available if they contain recognizable human speech or other human activities for which there may be concerns over privacy. In these cases, portions with private conversations may be excluded before delivery.

[8] Some data that can be used to calculate overall power production may be considered a sensitive trade secret and only released under a protective agreement.

3.0 COMPLAINT RESOLUTION

The following complaint resolution procedure assures that nearby residents' concerns regarding wind turbine noise are addressed in a timely manner while, at the same time, preventing abuse of the complaint process.

This complaint resolution process shall be in place for the life of the Facility and may be amended pursuant to Part 1002 of the Article 10 regulations (16 NYCRR 1002.2[j]).

The complaint resolution procedure shall be as follows:

3.1 | RECEIVING A COMPLAINT

1) Cassadaga Wind shall provide the name of the person who can be contacted in the case of a complaint, as well as the phone number by which that person can be reached, and post this with the Town Clerk of each town the Facility is located.
2) Cassadaga Wind shall provide an acknowledgement to the complainant of a properly filed complaint within two business days.
3) Because of the complexity of wind turbine noise complaint resolution, the full cooperation of the complainant and adherence to this protocol are necessary to its success.
4) Complainants are requested to provide to Cassadaga Wind the following information related to a potentially offending incident:
    a. Location at which the sound was observed;
    b. The date and time on which the sound was observed;
    c. Relevant weather conditions prevailing at the time the sound was observed. Such conditions would include, for example, presence of snow cover, cloudiness, any precipitation, and the approximate wind direction and speed.
    d. A description of the sound that was observed.
5) Cassadaga Wind shall record the complainant's information, as well as the meteorological conditions, turbine operating status, and turbine power output that were logged during the period indicated in the complaint.

3.2 | NOISE COMPLAINT RESPONSE

If (1) the complainant represents a permanent or seasonal residence within one mile of any turbine, and (2) based on monitoring and/or modeling, the sound level induced by the Facility is modeled to be greater than 40 dBA L_{1h} at the complainant's location, and (3) the sound is not related to Facility maintenance or abnormal operational conditions, then Cassadaga Wind will investigate the incident as follows:

1) Determine whether the sound level at the complaint location is likely to be greater than 40 dBA L_{1h} by reviewing the pre-construction sound modeling.
2) Cassadaga Wind shall respond to the complainant in each case. However, Cassadaga Wind is not required to conduct additional sound testing if:
    a) the modeled sound level is not greater than 40 dBA L_{1h}, or

b) the complaint has occurred as a result of abnormal operation. In this case, Cassadaga Wind shall make necessary repairs.

3) Cassadaga Wind shall conduct sound monitoring if:
   a) The complaint location is further than 0.5 miles from any post-construction sound monitoring locations, or
   b) If there is a reasonable possibility that conditions have changed that affect wind turbine sound levels, or
   c) The last sound monitoring was conducted more than five years ago, and
   d) Permission to access their property is granted by the complainant.
4) Cassadaga Wind will not, as a result of additional complaints, repeat sound monitoring in a representative area during any five-year period following the first complaint response procedure for that area, unless changes in system operation or turbine maintenance can be reasonably assumed to have resulted in higher turbine sound levels. This clause shall not be construed as impeding a party from petitioning the NYS DPS for additional sound level monitoring, nor does it exclude the NYS DPS from requiring additional sound level monitoring during this period in order to address extenuating circumstances.
5) During the first year of operation, sound monitoring in response to complaints will be addressed as part of the first-year Sound Monitoring Protocol in Section 2.
6) Cassadaga Wind may request that a Complainant maintain a written log of potentially offending sound events over some reasonable period of time, in order to assist in identifying influences that may affect the sound from the turbines. If the identified influences demonstrate that follow-up sound monitoring is warranted, Cassadaga Wind shall make all reasonable efforts to conduct such monitoring under conditions similar to those existing at the time the complaint arose.
7) Cassadaga Wind shall inform a resident when it intends to conduct any sound monitoring and cooperate with the resident to determine an appropriate location for the monitoring equipment. Monitor positioning will still be subject criteria to listed in Section 2.3.

3.3 | REPORTING

Cassadaga Wind shall submit a report with the official results of complaint-based monitoring to the complainant, the NYS DPS and the Town Clerk of the complainant town within 45 days of completion of that monitoring. This report shall include the following information as collected during the entire complaint monitoring period:

1) Wind speed and direction
2) Operational status of the turbines
3) Summary sound levels, and
4) Sound level data as logged by the sound level meter throughout the monitoring period in graphical form.

If, as the result of a complaint resolution, it is determined that the sound level attributable to the Facility, exceeds any noise limit set in the Certificate, Cassadaga Wind

shall take steps to identify the issue and evaluate practical measures to further minimize sound levels at the receptor as required under Condition 73 of the Certificate.

3.4 | VIBRATION COMPLAINTS

If the nature of the complaint is described by the complainant to be due to ground-borne or noise-induced interior vibration, a vibration test will be performed inside the complainant's residence if such permission is granted by the complainant.

1) The vibration test will compare Facility-only vibration to perception criteria, as outlined in ANSI Standard S2.71
2) Vibration measurement test procedures will follow those outlined in ANSI S2.71
3) Testing will comprise a measurement period of one hour, followed by measurement during the shutdown of all turbines within 1.5 miles of the residence for a period of 20 minutes, and measurement for the hour following the turbine restart.
4) Vibration measurement will only be performed if:
    a. The location is within one mile of the closest Facility wind turbine,
    b. Vibration measurements have not been performed at that particular location within the last five years, and
    c. The locations is at least 0.5 miles from the nearest location where vibration has been measured in the last five years.
5) Measurement results will be summarized in a memo that will be submitted to the complainant, NYS DPS, and the Town Clerk, within 45 days of the monitoring.
6) If turbine-only vibration exceeds ANSI S2.71 criteria, Cassadaga Wind shall take remedial steps to identify and mitigate the issue, consistent with Certificate Condition 73.

3.5 | AMPLITUDE MODULATION COMPLAINTS

If the nature of the complaint is described by the complainant to be suggestive of Amplitude Modulation (AM), monitoring will be performed at the complainant's residence, if permission for access is granted by the landowner and modeled sound levels are greater than or equal to 40 dBA L_{1h}.

1) AM measurement procedures will follow the guidelines of the British Institute of Acoustics Amplitude Modulation Working Group's *IOA Noise Working Group Final Report: A Method for Rating Amplitude Modulation in Wind Turbine Noise* (2016).
2) AM measurements will only be performed if:
    a. Modeled sound levels are greater than or equal to 40 dBA $L_{1h.}$
    b. AM measurements have not been performed at that particular location within the last five years, and

c. The locations is at least 0.5 miles from the nearest location where AM has been measured in the last five years.

3) Monitoring will last between one and two weeks.
4) Measurement results will be summarized in a memo that will be submitted to the complainant, NYS DPS, and the Town Clerk, within 45 days of the monitoring.
5) If AM exceeds standards in Condition 81 of the Certificate, Cassadaga Wind shall take remedial steps to identify and mitigate the issue as specified in the Certificate.

Exhibit B

NEW YORK STATE BOARD ON ELECTRIC
GENERATION SITING AND THE ENVIRONMENT

Case No. 14-F-0490	Application of Cassadaga Wind LLC for an Amendment of its Certificate of Environmental Compatibility and Public Need to Construct a Major Electric Generating Facility in the Towns of Charlotte, Cherry Creek, Stockton, and Arkwright, New York

TESTIMONY OF:

SYLVIA BRONESKE

RWE RENEWABLES

Q: Please state your name, employer, and business address.

A: Sylvia Broneske, RWE Renewables UK, Windmill Hill Business Park, Whitehall Way, Swindon, SN5 6PB, UK.

Q: Please describe your background and professional experience.

A: I am the Principal Acoustic Engineer and Technical Lead of the Acoustics Team for RWE Renewables, the parent company of Cassadaga Wind LLC. I have been working with wind turbines for more than 20 years in Germany, the United Kingdom and worldwide. I have worked for DNV GL as student and the wind turbine manufacturer Enercon in Germany after graduation with the German equivalent of a MSc in Environmental Engineering. I have been a Senior Acoustic Consultant and Head of Turbine Testing at the renowned UK acoustic consultancy Hayes McKenzie Partnership, during which time I obtained my MSc in Sound and Vibration at the University of Southampton/UK part-time. I have been an invited speaker, speaker/presenter at various conferences, I serve on the organizing committee of the biennial international conference on Wind Turbine Noise (organized by INCE-Europe) and I have been a panelist at numerous wind turbine conferences, speaking recently at the AWEA Wind Project Siting & Environmental Compliance Virtual Summit about international standardization. I am a participating member of two IEC[1] committees, one ISO[2] committee and several

[1] International Electrotechnical Commission
[2] International Standards Organization

national standardization committees at BSI[3]. I am the Secretary of the IEC project team IEC/PT61400-11-2 who is currently drafting the Technical Specification IEC/TS 61400-11-2: *Wind Energy Generation Systems – Part 11-2: Measurement of wind turbine noise characteristics in receptor position* where I work together with internationally renowned wind turbine acoustic experts such as employees from NREL and Jacobs from the USA, Aercoustics from Canada/USA and many others from Denmark, Germany, India to name but a few. I am also a member of the UK Institute of Acoustics where I regularly participate in their meetings and consultations. My resume is attached as **Exhibit "A".**

Q: What is the purpose of your testimony?

A: I am submitting this testimony in support of Cassadaga Wind's Petition to amend its Article 10 Certificate of Environmental Compatibility and Public Need ("Certificate") to eliminate the long-term sound limit (Condition 80(b)) and adopt Cassadaga Wind's Sound Monitoring and Compliance Protocol which is attached to the Testimony of Kenneth Kaliski ("Final Protocol").

Q: What does Condition 80(b) require?

A: Certificate Condition 80(b) requires that the Facility "[c]omply with a limit of 40 dBA L(night-outside), annual equivalent continuous average nighttime sound level from the Facility outside any existing permanent or seasonal non-participating

[3] British Standards Institution

residence, and a limit of 50 dBA L(night-outside), annual equivalent continuous average nighttime sound level from the Facility outside any existing participating residence."

Q: Are you aware of any other wind projects with a condition like 80(b)?

A: I have been involved in modeling and monitoring sound from wind projects all over the world for more than 16 years. I am working with international wind turbine acoustic experts in IEC and ISO standardization, and I regularly attend and present at the only international conference "Wind Turbine Noise" (https://www.windturbinenoise.eu) organized by INCE-Europe and attended by renowned international experts in the field. I am the Technical Lead of the Acoustics Team at RWE Renewables and we participate regularly in research internally and externally with respect to wind turbine acoustic.

To the best of my knowledge, Cassadaga Wind is the only wind farm in the world with an annual regulatory limit requiring long-term monitoring at the receptor position to demonstrate compliance.

Q: Is there any standard for measuring wind turbine sound for an annual average?

No (international or national) standard nor guidance exists for measuring annual average wind turbine sound immissions as required by Cassadaga's Certificate. Accurately monitoring sound immissions from a wind farm over the course of a

year will be extremely difficult, time consuming and costly, even under the long-term protocol developed by RSG (April 17, 2018 Protocol).

Q: Has RWE estimated how much a long-term protocol will cost?

A: With regards to costs, we estimate that the long-term protocol will cost between $150,000 and $312,000 to implement, depending on the total number of shut downs required and whether the protocol requires attended monitoring, which DPS Staff has requested. Attended monitoring will require multiple field staff to be present at the same time. In addition to the monitoring cost, we will also incur extended loss of electricity production. It makes little sense to lose out on clean electricity production to accommodate an unprecedented and uncertain monitoring campaign with questionable outcome with regards to the protection of residents and human response to wind farm noise (which is not an annual average response but a shorter-term response). This cannot be in anyone's interest.

By way of comparison the short-term protocol proposed by RSG in their affidavit requires 28 hours of shutdowns and costs $89,000 for monitoring only. Notwithstanding the cost, the uncertainty of the measurement and inaccuracy of the results are a much bigger issue.

Q: Is long-term sound monitoring for annual noise limits suitable for wind farm sound?

A: Requiring long-term sound monitoring for annual noise limits is not industry best practice and is not advocated by experts in the wind turbine acoustics field. I have

spoken with my colleagues and fellow experts at the IEC wind turbine acoustic expert group, and we all agree that annual noise limits and long-term monitoring at the receptor position to show compliance with an annual noise limit are not suitable for wind farm sound. It should be noted that the **international expert group** at IEC/PT61400-11-2 has decided **not** to include a reference to the annual average metric L_{den}[4] or L_{night} or annual measurements for compliance in the draft IEC Technical Specification IEC/TS 61400-11-2[5]. The IEC Technical Specification will recommend short-term L_{Aeq} or L_{A90} measurements (1 minute or 10 minute average) as the appropriate measure to assess the impact of wind farm sound at receptor position. (This statement relates to the current draft of the TS and the relevant discussions as of November 10th, 2020)

Q: Are you aware of any other wind projects with a condition like 80(b)?

A: No. To my knowledge, Norway and The Netherlands are the only countries worldwide, that we currently operate in, that have annual noise limits also adopted for wind turbines but neither of these countries require receptor monitoring to demonstrate compliance.

a. In The Netherlands, annual noise limits do apply to the source 'wind turbine' (and other sources of noise) and are defined in *Staatscourant Nr*

[4] "den" stands for day/evening/night to describe a different time weighting of measured/predicted noise levels depending on time of day

[5] Expected to be submitted to IEC national member committees in 2021 for consultation and publication in 2022 the latest.

19592 23 December 2010. It states, translated from Dutch, in Section 2.6 of Appendix 4: "Enforcement by means of immission measurements is not really possible due to the influence of [other] noise and problems with regard to representativeness. That is why enforcement measurements are focused on **monitoring the sound power [level]**."

Sound power level measurements in accordance to IEC 61400-11 are carried out in the vicinity of an individual wind turbine, approximately at a distance of hub height plus half a rotor diameter in downwind direction on a hard board on the ground. These are short-term measurements with a measurement period of 10 sec which is appropriate at the wind turbine to capture the fluctuation of sound emissions directly at the source. The determination of the sound power level of the source is then used to show compliance with the noise limits by modeling the sound level at the receptor with the measured data as input and long-term predictions of the meteorological conditions in the same way as when showing compliance with noise limits for the permit application.

b. In Norway *Veileder til retningslinje T-1442 Behandling av støy i arealplanleggingen* (last revision 2020) defines noise limits and guidance for wind turbine noise. It states in section 9.8.5, translated from Norwegian, that "Long-term immission measurements are demanding, expensive to carry out and there is **great uncertainty** associated with the result due to

background noise, among other things. This type of measurement is therefore **not recommended** to check whether the license conditions are met. Immission measurements can, however, be used to document "instantaneous values", i.e. average values over a relatively short period of time."

Immission measurements are the measurements of sound pressure levels at the receptor location.

Q: Why should Condition 80(b) be eliminated from Cassadaga's Certificate?

A: As part of the evidence submitted for the Baron Winds (Case 15-F-0122, information request DOH-1), the response submitted by Dr. Krispian Lowe and Charles Readling (January 15, 2019), listed the reasons against an annual average noise limit. The subsequent Baron Winds Article 10 certificate omitted any reference to long-term annual average noise limits and any corresponding monitoring requirements.

Even, the WHO[6] has stated that the annual metrics L_{den} and L_{night} are poor acoustic measures for wind turbines as follows: "Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a **poor characterization** of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes."

[6] World Health Organization

The factors supporting this conclusion are set forth in detail in Section 3.4.2.3 of the WHO 2018 Guidelines (pp. 84-86).

Moreover, no guidance has been given by the WHO on the use of wind data to obtain a L_{den} and L_{night} from wind farms, which is a noise source where magnitude is highly dependent on wind speed and for the receptor also wind direction. This is variability of source strength which is not predictable like a train or airplane timetable, has not been considered and is unlike other noise sources included in the WHO document. Most importantly **no guidance** has been given on the enforcement and measurement of such a limit.

In conclusion, as articulated in the WHO 2018 Guidelines, "…the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise…" As a result, providing an assessment with L_{night} for Cassadaga Wind Farm would not add any value to the already submitted noise studies. There is no guidance nor requirement of long-term immission measurements in any of the few countries known to us, that has implemented long-term L_{den} noise limits. On the contrary, their legislation **unanimously** points out, that the **measurement is not representative** nor repeatable, costly and afflicted with a great uncertainty. There is no value in carrying out such long-term measurements if the result has an unknown uncertainty and cannot be considered to be repeatable and representative of the sound source nor of human response to wind farm sound.

Q: Does this conclude your testimony?

A: Yes.

Exhibit A
to Broneske Testimony

CURRICULUM VITAE

Name: Sylvia BRONESKE Date of Birth: 27/04/76

Education:

1995-1999 University of Stuttgart, Germany
Environmental Engineering, Intermediate Examination

1999-2004 University of Applied Sciences Hamburg, Germany
Diplom-Ingenieur (Environmental Engineering)

2009-2015 University of Southampton, Institute of Sound and Vibration Research (ISVR), UK
MSc Sound and Vibration, part-time

Employment:

2002-2004 Windtest Kaiser-Wilhelm-Koog GmbH, Germany (subsequently part of GL Garrad Hassan, which is now DNV GL)
STUDENT CONSULTANT/ENGINEER
Noise measurements and noise impact assessment for wind farm developments in Germany. Wind turbine source noise measurements.

2004-2007 Enercon GmbH, Germany
ENGINEER/CONSULTANT
Noise and shadow impact assessment for wind farm developments. Supervising noise measurements of Enercon wind turbines. Advising co-workers, authorities, clients/developers and wind farm neighbours in wind turbine noise-related issues. Solving complaints about wind farm noise and optimisation of noise critical wind farm sites. Calculating periods of shadow flicker and programming ENERCON shadow shutdown system to prevent shadow flicker at surrounding properties.

2007-2016 Hayes McKenzie Partnership Ltd, Salisbury/UK
SENIOR CONSULTANT and HEAD OF TURBINE TESTING
Project management and preparation of Environmental Impact Assessments for wind farm developments in the U.K. and Republic of Ireland. Measurement and assessment of wind farm noise for planning purposes and compliance with planning conditions. Evaluation of turbine types for consented wind turbine projects. Source noise measurements on wind turbines, particularly small wind turbines. Managing wind turbine source noise data base. Health and Safety. Assistance with evidence for Public Inquiry. Expert Witness at Appeal Hearing in Scotland.

Successful implementation of IEC 61400-11:2012 for all size of wind turbines. Main focus on certification measurements of small wind turbines in UK and warranty testing of larger wind turbines.

Head of Turbine Testing Department. 2016 certification as measurement laboratory to ISO 17025 (only two labs obtained this certification in 2016 in the UK) for IEC 61400-11 sound power level measurements

Presentations of various subjects in relation with wind farm noise at national and international conferences.

Organiser of workshop on the implementation of IEC 61400-11 Ed.3 at the Wind Turbine Noise Conference 2013 in Denver and 2015 in Glasgow.

2016-present innogy Renewable UK Ltd., Swindon/UK (innogy SE), since July 2020 under new name RWE Renewables
PRINCIPAL ACOUSTICS EXPERT
TECHNICAL LEAD ACOUSTICS TEAM
Conducting country specific noise impact assessment, technical due diligence worldwide, acoustic advise at all project stages (development, construction, operation and de-construction). Provision of specialist expertise and internal coordination of acoustic related issues. Complaints investigation. Supervision and technical coordination of sound power and immission measurements on RWE wind parks worldwide. Managing and conducting of internal monitoring, third-party requirements. Noise assessment of battery storage units and transformer. Support of the Offshore wind in compliance with noise regulation during construction in particular of onshore facilities. Acoustic consultancy services for other (RWE) business units. Contract negotiations with equipment manufacturers (sound warranties). Expert witness in wind turbine acoustic matters.
Responsibility for the Acoustics Team in all technical decisions. Integration of the Acoustics Team into the new RWE organisation.

Publication: Vick, Brian and Broneske, Sylvia: EFFECT OF BLADE FLUTTER AND ELECTRICAL LOADING ON SMALL WIND TURBINE NOISE, Reference: RENE4937, Journal title: Renewable Energy, Final version published online: 26-SEP-2012 Full bibliographic details: Renewable Energy (2013), pp. 1044-1052 DOI information: 10.1016/j.renene.2012.08.057

Presentations: Several Institute of Acoustics One-Day Conferences on Wind Turbine Noise, Environmental Noise and Measurement Equipment

Small Wind Turbine Noise at Renewable UK Conference 2012

Wind Turbine Noise Conference 2009 in Denmark (*Comparison of Wind Turbine Manufacturer's Noise Data for Use in Wind Farm Assessments*), Wind Turbine Noise Conference 2013 in USA, Invited Speaker at Internoise 2014 in Australia, Wind Turbine Noise Conference 2017 in The Netherlands (Co-Author of presentation), Wind Turbine Noise Conference 2019 in Lisbon/Portugal,

Several workshops at KCE Academy in Germany for Local Authorities and Developers

Professional Bodies:	Member, Institute of Acoustics IOA Member, Verein Deutscher Ingenieure VDI (Institute of German Engineers)

Member of the organising committee for the Wind Turbine Noise Conference since 2015 organised by INCE Europe

Standardisation:	Chairperson of BSI[1] shadow sub-committee PEL88/-/08 to IEC[2] 61400-11 MT11 and PT11-2 (Wind Turbine Acoustics
	Secretary of IEC PT61400-11-2 (*Immission Measurements of Wind Turbine Noise*)
	Member of IEC MT61400-11 (*Sound Power Level Wind Turbines*)
	Member of BSI EH/1/3 sub-committee (*Residential and industrial noise*)
	Member of ISO[3] working group ISO/TC 43/SC 1/WG 45 (*Description and measurement of environmental noise – ISO 1996 series*)

[1] British Standards Institution
[2] International Electrotechnical Commission
[3] International Standards Organization