BEFORE THE
STATE OF NEW YORK
BOARD ON ELECTRIC GENERATION
SITING AND THE ENVIRONMENT

In the Matter of

Baron Winds LLC

Case 15-F-0122

February 22, 2019

Prepared Testimony of:

REDACTED

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Q. Will you please state your name, employer, and business address?

A. My name is Miguel Moreno-Caballero and I am employed by the New York State Department of Public Service (DPS or the Department), located at Three Empire State Plaza, Albany, New York, 12223.

Q. Mr. Moreno what is your position at the Department?

A. I am a Utility Engineering Specialist 3 (Acoustics) in the Environmental Certification and Compliance section of the Office of Electric, Gas and Water (Staff).

Q. Please summarize your educational background and professional experience.

A. I attended the Pontifical Xaverian University in Bogota, Colombia and received a Bachelor of Science degree in Civil Engineering in 1986. Thereafter, I continued my education at Universidad del Norte in Barranquilla, Colombia and graduated with a Masters in Business Administration in 1992. I have accumulated more

than 20 years of experience in the field of acoustics and noise control. I owned and operated my own business in Colombia, South America for about 13 years, where I worked as an acoustical consultant and acoustical contractor. I designed and built noise abatement solutions for emergency generators, industrial machinery, HVAC equipment, and interior acoustical designs for indoor spaces. I obtained extensive experience in noise control including noise surveys and computer simulations of aircraft noise for two international airports.

After my arrival to the United States, I was employed as a Senior Acoustical Consultant by an acoustical consultant firm in Washington D.C., from October 2005 until May 2008. There, I analyzed sound surveys and performed computer noise modeling for roadways and highways and designed mitigation measures such as barriers and selected building envelope specifications for environmental noise control. I also designed noise control solutions for mechanical

equipment and interior acoustics for indoor spaces for a variety of projects. From May 2008 to June 2009, I was employed by an acoustical consultant company in Manhattan and worked for several acoustical and noise control projects including data centers and corporate projects.

I joined the Department in November 2013. My duties include reviewing Public Service Law (PSL) Article VII and Article 10 pre-applications, applications, environmental noise assessments, noise surveys and mitigation measures. I also review sound collection protocols and witness sound measurements to ensure compliance with Certificate Conditions. I am a full-member of the Institute of Noise Control Engineering and an Associate member of the Acoustical Society of America.

Q. Mr. Moreno, which projects have you reviewed under PSL Article 10 and Article VII regulations?

A. Under Article VII regulations, I have reviewed the applications for the following certified

cases: New York Power Authority, Case 13-T-0515; DMP New York, Inc., Williams Field Services Company LLC, Cases 13-T-0538 and 13-T-0350; PSEG Power New York, Inc. Case 15-F-0040; and Consolidated Edison Company of New York, Inc., Case 13-T-0586. Although currently pending or uncertified, I also reviewed environmental noise assessments for the following Article VII projects: West Point Partners LLC, Case 13-T-0292; Poseidon Transmission, LLC, Case 13-T-0391; In the Matter of Alternating Current Transmission Upgrades – Comparative Proceeding, Case 13-E-048; Vermont Green Line Devco, LLCI, Case 16-T-0260; and Niagara Mohawk Power Corporation, Case 15-T-0305. I am currently working on numerous PSL Article 10 proceedings (and some potentially affiliated Article VII filings) regarding wind generating facilities at various stages including the following projects: Cassadaga Wind, LLC, Case 14-F-0490 already certified by the New York State Board on Generation siting and the Environment (Siting

Board); Lighthouse Wind, LLC, Case 14-F-0485; Baron Winds, LLC, Case 15-F-0122; Bull Run Energy, LLC, Case 15-F-0377; Eight Point Wind, LLC, Case 16-F-0062; Atlantic Wind, LLC -Deer River, Case 15-F-0267; Canisteo Wind Energy, LLC, Case 16-F-0205; Case 16-F-0267;; Number Three Wind LLC, Case 16-F-0328;; Heritage Wind LLC, Case 16-F-0546; Bluestone Wind, LLC, Case 16-F-0559; Alle-Catt Wind Energy, LLC, 17-F-0282 and Atlantic Wind, LLC, -Mad River-,Case 16-F-0713. I am also assigned on multiple PSL Article 10 proceedings (and some potentially affiliated Article VII filings) regarding solar generating facilities at various stages including the following projects: Mohawk Solar, LLC, Case 17-F-0182; Hecate Energy Albany 1, LLC and Hecate Energy Albany 2, LLC, Case 17-F-0617; and Hecate Energy Greene County 1, LLC, Hecate Energy Greene 2, LLC, and Hecate Energy Greene County 3, LLC, Case 17-F-0619.

Q. Are you sponsoring or relying upon any other exhibits?

A. Yes. I am sponsoring Exhibit__(MMC-1); through Exhibit__(MMC-13).

Q. Please briefly describe those exhibits.

A. Exhibit__(MMC-1) contains the document entitled "Guidelines for Community Noise," World Health Organization, 1999 (WHO 1999), which I will refer to as "WHO-1999."

Exhibit__(MMC-2) contains a link to download the document entitled "Guidelines and Recommendations," which I will refer to as "WHO-2009."

Exhibit_(MMC-3) contains an executive summary of the most recent guidelines from the World Health Organization (WHO) regional office for Europe entitled "Environmental Noise Guidelines for the European Region," published in October 2018, which I will refer to as "WHO-2018-ES."

Exhibit_(MMC-4) contains the most recent guidelines from the WHO regional office for Europe entitled "Environmental Noise Guidelines for the European Region," published in October 2018, which I will refer to as "WHO-2018."

Exhibit_(MMC-5), contains a study entitled "Massachusetts Study on Wind Turbine Acoustics. Prepared for: Massachusetts Clean Energy Center and Department of Environmental Protection. Submitted by RSG Inc. Report 2.18.2016," which I will refer to as the "MA-STUDY-2016" in my testimony.

Exhibit_(MMC-6) contains my notes on Figure 26, page 69 of the MA-STUDY-2016.

Exhibit__(MMC-7) contains a Sound Testing Compliance Protocol that I have developed and am proposing for this Project which I will refer to as "DPS-Protocol."

Exhibit__(MMC-8) contains Table 2 of a reference called "Percentiles of Normal Hearing-Threshold Distribution Under Free-Field Listening Conditions in Numerical Form." Kenji Kurakata, Tazu Mizunami, and Kuzama Matsushita. Acoust. Sci. & Tech. 26, 5 (2005), which I will refer to as "KURAKATA-2005."

Exhibit__(MMC-9) contains a drawing showing the turbines proposed for this Project and the

locations of non-participating residences differentiated to indicate the non-cumulative mitigated short-term noise levels reported in the Application.

The Certificate Conditions that I am proposing on noise and vibration are contained in Exhibit__ (SSP-2) which contains all Staff-Policy Panel sponsored Certificate Conditions for this Project.

Exhibit__(MMC-10) contains an alternative to the certificate conditions on noise and vibration for this Project that I am presenting for consideration, including both a redlined and a clean version.

Exhibit__(MMC-11) contains a redlined comparison between the certificate conditions proposed by the Applicant and the Certificate Conditions imposed by the Siting Board in Case 14-F-0490.

Exhibit__(MMC-12) contains a drawing showing the turbines proposed for this Project and the locations of non-participating residences differentiated to indicate the cumulative

mitigated short-term noise levels reported in the Application.

Exhibit__(MMC-13) contains my preliminary comments and edits on the protocols presented in the Application.

Q. Mr. Moreno, what is your role under PSL Article 10 regulation review?

A. Under Article 10, my duties include the review of preliminary scoping statements, stipulations and applications as they relate to the noise assessments and avoidance or minimization of environmental noise impacts from major electric generation facilities. My role regarding wind generating projects consists of the review of sections of the Application related to noise impact assessments from construction and operation of the facilities, which includes pre-construction ambient noise surveys, analysis of existing or potential future prominent tones, noise modeling parameters, assumptions and results, amplitude modulation, low-frequency noise, infrasound, potential for hearing damage,

indoor and outdoor speech interference, interference with the use of outdoor public facilities and public areas, community complaint potential or annoyance, and the potential for interference with technological, industrial or medical activities that are sensitive to vibration or infrasound. In addition, my role also includes the review of applicable noise standards and guidelines, local regulations on noise, design goals for the facilities, noise abatement measures, complaint and resolution plans for noise from construction and operation of the Facility, and proposed post-construction noise evaluations and compliance for conformance with Certificate Conditions.

Q. Why is the noise expected to be generated from the Baron Winds LLC Facility (Facility or Project) an important issue for the Siting Board to consider in this proceeding?

A. Public Service Law §164 and the implementing regulations at 16 NYCRR §1001.19, require an applicant for a Certificate of Environmental

Compatibility and Public Need (Certificate), to provide certain information concerning the noise and vibration impacts of the construction and operation of a facility. In addition, the various noise levels expected from a major electric generating facility, including a wind generating facility like this Project, are important factors in determining the nature of the probable environmental impacts of the construction and operation of the proposed facility and whether it avoids or minimizes environmental impacts to the maximum extent practicable.

Q. Can you please describe the different labels such as L_{eq}, and the L_{90}, often used to describe noise levels?

A. Noise levels frequently fluctuate over a wide range and over time, so different sound descriptors have been developed to describe sound pressure levels over a period of time. The "Leq" is the equivalent-continuous sound pressure level of a noise source. It is the

single sound pressure level that, if constant over a specified time period, would contain the same sound energy as the actual monitored sound that varies in level over the measurement period. Guidelines for noise are sometimes expressed in terms of maximum noise levels specifying the period of time over which the measurements are taken. For example, 45 dBA $L_{eq\ (8\ hours)}$ means that the noise levels evaluated during 8 hours have an energy average equivalent to a constant level of 45 dBA.

Q. What is a percentile level?

A. The Ln is the percentile level, where n is any number between 0 and 100. The number designated by n corresponds to the percentage of the measurement time period by which the stated sound level has been exceeded. (James P. Cowan, Handbook of Environmental Acoustics, J. Wiley [1994], p. 41). For instance, the L90 is the sound level that is exceeded 90 percent of the time, usually regarded as the "residual level" or the background noise without the source in

question or discrete sound events (Cowan, p. 41).

Q. What does the designation "dBA" Mean?

A. "dB" is a designation for "decibel" which is equivalent to a tenth of a "Bell" (a unit named after Alexander Graham Bell). A Bell is too large to describe the acoustic environment and for that reason was broken into tenths or "decibels." (Cowan, p. 41). The "A" letter after the "dB" designation denotes one of the most common weighting networks in acoustics and noise control. The human ear does not sense all frequencies in the same manner, and the human ear does not hear sounds at different frequencies the same way a typical microphone in a sound level meter does. (Cowan p. 36). For that reason, the "A-weighted" scale was developed and is comprised of a series of corrections applied to the sound levels measured by a sound level meter at all frequencies of the human audible spectra to resemble human hearing. (Cowan p. 31). Although the normal hearing range

in humans goes from 20 Hertz up to 20,000 Hertz, humans are more sensitive to sound with frequencies between 200 Hertz and 10,000 Hertz (Cowan p. 36) and for that reason the greatest corrections are applied to the low frequencies. (e.g. minus 57 dB at 16 Hertz). In addition, we hear the sound levels between 500 Hertz and 4,000 Hertz similar to the way it is perceived by a sound level meter microphone and for that reason the corrections are lower ranging from minus 3.2 dB at 500 Hertz up to 1.0 dB at 4,000 Hertz. After all corrections are applied to each frequency sound level, the individual contributions to the dBA level are added up and the result is noted as "overall," "broadband" "dBA" or "dBA-weighted" noise level.

Q. Does the proposed Project avoid or minimize the adverse environmental noise impacts to the maximum extent practicable?

A. No. I believe that potential adverse environmental noise impacts from operation of the facility have not been avoided or minimized

to the maximum extent practicable. Forecasting of operational noise levels from the Project only shows conformance with relevant criteria if noise reduction operations (NRO's) on the wind turbines are incorporated in the computer noise modeling during the design phase. Should actual sound levels exceed relevant criteria at the most potentially impacted noise receptors after a project is built, the room for increasing noise reduction operations further may be limited and it will reduce power generation. In addition, I recommend that the Project should be evaluated not only based on its sound impacts on sensitive noise receptors but more importantly in a cumulative basis with the interaction of noise emissions of the adjacent operational Cohocton Generating Facility. Sound impacts are greater when they are evaluated in conjunction with the noise emissions from the existing facility. In addition, I do not find the Certificate Conditions proposed by the Applicant and the protocol for post-construction

evaluations to be appropriate for this Project.

Q. Please explain your general impressions of the Certificate Conditions proposed in the Application for this Project.

A. I find that the Application Certificate Conditions proposed for Baron Winds have many issues that are similar to those litigated and ultimately decided by the Siting Board in Case 14-F-0490 Cassadaga Wind LLC. For this reason, I may not reiterate many of those issues but will compare how the Certificate Conditions proposed by the Applicant for Baron Winds LLC compare with the Certificate Conditions imposed by the Siting Board for Cassadaga Wind LLC. To illustrate the similarities and to expedite review, I have provided a redlined tracked comparison between the approved Certificate Conditions for Cassadaga Wind and those proposed by Baron Winds, which is included in my testimony as Exhibit MMC-11.

Q. Please explain the results of sound impacts included in the most recent Application

Supplement dated February 1st, 2019.

A. The Application has proposed a short-term design goal of 45 dBA Leq for all non-participating residences and cabins. According to the supplemental information, the new design complies with that limit for nonparticipating residences and cabins. However, I note that to comply with that goal, two turbines needed to be turned-off from the computer noise modeling and Noise Reduction Operations (NRO's) on several turbines have been needed to be incorporated into the model as well. As I will explain in my testimony, my recommendation is not to use NRO's during the siting process or design phase but leave them as contingency options in case post-construction mitigation is needed.

Q. Please explain what a Noise Reduction Operation (NRO) is.

A. As explained in the Preconstruction Noise Impacts Assessment presented with the original Application (pp. 142-143), NROs are changes introduced to the operation of the wind turbines

to reduce noise generation. This is usually accomplished by adjusting turbine blade pitch, slowing the rotor speed of the turbines, which reduces aerodynamic noise produced by the blades.

Q. How many turbines needed NRO's or being turned-off from computer model so that the Project complies with a maximum short-term noise level of 45-dBA-Leq-1h.

A. According to the information included in the most recent supplement, three turbines were turned-off from the computer noise model (T1, T72, and T74) and NRO's were applied on twenty eight turbines: five turbines were modeled with 5 dBA NRO's, one turbine with an NRO of 4.5 dBA, three turbines with NRO's of 4 dBA, six turbines with NRO's of 3 dBA, six turbines with NRO's of 2 dBA and seven turbines with NRO's of 1 dBA .

Q. Has the Application Supplement stated whether NRO's are available and has the Supplement included Sound Power information from the manufacturers?

A. The Application Supplement states: "In the case of Gamesa G114, the sound spectrum used was obtained from an IEC 61400-11 test of the turbine, for the wind speed with the maximum sound power emissions. This spectrum was then scaled to the published apparent sound power for this turbine." What this means is that the sound power level information at different frequencies of the spectra was only available for the wind speed that generates the maximum sound power levels but not for lower speeds. As I will explain later in my testimony, this may have implications in the calculation of long-term noise impacts at sensitive receptors.

Q. What are the short-term impacts from the Facility without NRO's applied on the turbines?

A. Nineteen non-participating residences are forecasted to exceed a noise level of 45 dBA-Leq-1-h. The maximum noise impact is modeled to be as high as 49 dBA. In addition, two cabins are forecasted with short-term noise levels greater than 45-dBA-Leq-1-h, one of them with

levels as high as 55-dBA-Leq-1-h.

Q. Those are the results from the proposed Project only. What would the results be in combination with the existing operational Cohocton Wind Facility?

A. Without turbines T1, T72 and T74 and with NRO's applied to the turbines, there are eight non-participating receptors and one non-participating cabin with short-term levels exceeding 45-dBA-Leq-1-hour sound levels. If turbines T1, T72 and T74 are not eliminated and if NRO's are not used for computer noise modeling, the number of residences exceeding a noise level of 45 dBA-leq-1-hour goes from 19 to 36, with sound levels as high as 50-dBA (there is one receptor forecasted as high as 58 dBA but it seems to be caused by sound emissions from the Cohocton facility). In addition, the number of cabins exceeding 45-dBA-Leq-1-h goes from two to three.

Q. What are the noise levels from the Cohocton facility exclusively?

A. According to the information provided in the Supplement, four receptors already exceed a noise level of 45-dBA-Leq-1-h because of sound emissions generated by the Cohocton facility.

Q. What is your recommendation for evaluating cumulative noise impacts? Should a wind generating facility be evaluated exclusively on its noise impacts or in combination with the noise impacts from any other existing wind generating facilities in the vicinity?

A. In my opinion, for facilities proposed on locations that are proximal to other existing or proposed facilities, only a cumulative assessment reveals the severity of the impacts that may occur. Although the noise impacts from the proposed facility are important, the cumulative impacts are in those cases, more important. The issue under discussion is not new. In my review of relevant references, I found that this question was properly addressed by the Noise Working Group in the implementation of the regulations for wind farms in the United

Kingdom. In the final report of the reference entitled "The Assessment and Rating of Noise from Wind Farms," dated September 1996, the Noise Working Group discussed its findings in section 11 of the executive summary, noise limits, page vi. The report represents the consensus of the group of experts that had "a breadth and depth of experience in assessing and controlling the environmental noise impact of noise from wind farms." Point 16 concludes: "The Noise Working Group is of the opinion that absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area contributing to the noise received at the properties in question. It is clearly unreasonable to suggest that, because a wind farm has been constructed in the vicinity in the past which resulted in increased noise levels at some properties, the residents of those properties are now able to tolerate higher noise levels still. The existing wind farm should not

be considered as part of the prevailing background noise."

Q. How is this conclusion applicable to this Project?

A. Both the World Health Organization guidelines (1999, 2009 and 2018) and the NYS Siting Board in Case 14-F-0490 have recommended and adopted "absolute" thresholds. From an impacted receptor perspective, it is more important how much wind turbine noise is perceived at that receptor in total, than knowing who is responsible for one portion of the noise or the other. The same applies to perceptible airborne vibrations and prominent tones: it is more important to know whether they will occur or exceed a limit than to know how much is caused by one facility or the other. In my opinion, if noise levels from an existing facility are already equal to or exceed any identified threshold, there is no more room for additional noise. If, on the other hand, noise levels from an existing facility are lower than any

identified threshold, the new proposed facility(ies) should be designed so that the cumulative noise levels are lower than or at most equal to that identified threshold. This requires that any project(s) proposed in close proximity to other existing or proposed projects locate its turbines at some distance from other existing or proposed turbines in the project area. For Baron Winds, the two projects overlap, with Baron Wind's turbines surrounding existing turbines from the Cohocton Generating Facility.

Q. Do you think that a short-term goal of 45 dBA-Leq-1-h is sufficiently protective of any noise impacts.

A. No, I do not. The Applicant selected a 45-dBA-Leq-1-h based on the outdoor recommendation from WHO-1999 for the nighttime, however, there is no discussion of another recommendation from WHO-1999, which is not to exceed an indoor noise level of 30-dBA-Leq-8-hour indoor during the nighttime.

Q. Is it possible that the Facility as designed could comply with an indoor noise level of 30 dBA-Leq-8-h during the nighttime?
A. Not in the summer. If people open the windows during the nighttime, indoor noise levels could be greater than 30 dBA. For Cassadaga Wind, the discussion was based on the assumption that the outdoor-to-indoor noise reduction provided by a building envelope was 15-dBA. However, I have found evidence that the outdoor-to-indoor noise reduction may not be as high as 15-dBA, warranting lower outdoor noise levels so that the 30-dBA-Leq-8-hour indoor recommendation is met.
Q. What is that evidence?
A. The new guideline from WHO, which I refer to as WHO-2018, in section 2.2.2., page 9, states: "The differences between indoor and outdoor levels are usually estimated at around 10 dB for open, 15 dB for tilted or half-open and about 25 dB for closed windows. When considering more accurate estimation of indoor levels, using a

range of different predictors, the relevant scientific literature can be consulted (Locher, et al., 2018).” (Locher B, Piquerez A, Habermacher M, Ragettli M, Röösli M, Brink M et al. (2018). Differences between outdoor and indoor sound levels for open, tilted, and closed windows. Int J Environ Res Public Health. 15(1): 149).

Q. Has this been corroborated by other authors?

A. Yes. In the article entitled “Wind Turbine Noise and Sleep: Pilot Studies on the Influence of Noise Characteristics” by Julia Ageborg Morsing, Michael G. Smith, Mikael Ögren, Pontus Thorsson, Eja Pedersen, Jens Forssén and Kerstin Persson Waye, I found that the difference between the LAeq,8h outdoor and indoor for windows with a gap was between 10.5 dBA and 10.9 dB (See table 1 of the article). In that case, indoor levels were measured at the pillow position. In another study in the same reference (Study B), the outdoor-to-indoor noise reductions were about 12.2 dB for windows with a gap. In another

article entitled "Wind Farm Noise: Paper ICA 2016-440. Physiological effects of wind turbine noise on sleep," by Michael G. Smith, Mikael Ögren, Pontus Thorsson, Eja Pedersen and Kerstin Persson Waye, published in Buenos Aires on September 2016, I found information that allowed me to conclude that for that study the outdoor-to-indoor noise reduction provided by windows slightly open was 12 dBA (See Table 1). I find that an assumption between 10 to 12 dBA is reasonable.

Q. What are the implications of this?

A. That outdoor noise levels should be between 40 and 42 dBA leq-8-h, but not greater than 42 dBA, so that the recommendation of 30 dBA-8-hour indoor during the nighttime from WHO-1999 is met.

Q. Is the outdoor noise limit of 45 dBA-Leq-8-h that WHO recommended in 1999 still Applicable?

A. No. WHO withdrew this recommendation in October of 2018.

Q. Is the indoor noise limit of 30 dBA-Leq-8-h that

WHO recommended in 1999 still Applicable?
A. Yes. This recommendation was retained by WHO in the most recent guideline (WHO-2018).
Q. If noise levels should not be more than 42 dBA-Leq-8-hour during the nighttime to comply with the 30 d-BA indoor recommendation, how many receptors for the proposed Facility exceed an outdoor noise level of 42 dBA?
A. If noise reduction operations are applied in the model and turbines T1, T72 and T74 are turned off, 30 receptors are expected to exceed 42-dBA Leq-1-h or 8-h. If noise emissions from the Cohocton facility are added, 55 receptors may exceed 42-dBA-Leq-1-h. If noise reduction operations are not used in the model, turbines T1, T72 and T74 are not eliminated and Cohocton impacts are accounted for, 90 receptors are expected to exceed 42 dBA-Leq-1-h.
Q. How are the long-term noise impacts evaluated?
A. The long-term noise impacts are evaluated with the use of the Lnight noise descriptor. The Lnight is an energy-based average of all the

noise levels during the nighttime period in a year.

Q. Is there any recommended limit?

A. Yes. In 2009, WHO recommended not to exceed 40 dBA Lnight – a recommendation that the Siting Board adopted for Case 14-F-0490 by imposing a certificate condition to be demonstrated with post-construction sound measurements.

Q. What are the estimated long-term impacts from the proposed Facility?

A. With noise corrections applied to the results, the Application concludes that no receptor will be exposed to noise levels greater than 40 dBA Lnight.

Q. Do you agree with that conclusion?

A. No, I do not. I believe that the real impacts may be greater.

Q. Why?

A. Because noise corrections were applied to the calculations so that the estimates with the CONCAWE corrections do not exceed the results with the ISO-9613-2 with no meteorological

corrections and because random numbers have been introduced in the calculations.

Q. Do you have any concerns with long-term sound levels as proposed by the Applicant?

A. In Cassadaga Wind, the Siting Board imposed Certificate Condition 80(b), which includes a sound 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. That clause is not included in the Certificate Conditions proposed by the Applicant for Baron Winds or the protocol for post-construction noise evaluations.

Q. Do you agree with excluding testing of the Lnight-outside regulatory limit from the scope of the compliance testing protocol?

A. No, I do not. The 40 dBA L(night-outside)

requirement for non-participating receptors, which is based on the recommendations of WHO-2009, is potentially more protective than the 45 dBA-Leq (8-hour) WHO-1999 recommendation and, therefore, should be evaluated at the most critical locations after the Project is built. Alternatively, the Project should be designed for a lower short-term limit as previously stated.

Q. Is the WHO-2009 still applicable?

A. Yes. As stated in the most recent guideline (WHO-2018, p. 28) "the current guidelines complement the NNG [WHO Night Noise Guidelines] from 2009."

Q. Does the Application include computer noise modeling and calculations showing that the design complies with the 40 dBA-Lnight recommendation of WHO-2009 for non-participating receptors?

A. Yes. The Application claims that the maximum impact will be 40-dBA at non-participating receptors. Also, it claims that a maximum level

of 50-dBA Lnight will not be exceeded at participating receptors.

Q. Do you have any issues regarding how the Lnight levels were calculated and if so, could you please describe what those issues are?

A. Yes. The calculations of the Lnight in the Application included corrections on an hourly basis so that the results with the ISO 9613-2/CONCAWE method never exceed the Leq-1-hour calculated with the ISO 9613-2 at the particular wind speed that occurs during each hour.

Q. Please explain.

A. The Application adopted two methods for prediction of future operational noise levels from the Project called the ISO-9613-2 and the CONCAWE. The ISO-9613-2 method uses the ISO 9613-2 propagation standard with no meteorological corrections to estimate the short-term sound levels as I explained previously in my testimony and the CONCAWE method uses the ISO 9613-2 propagation standard in conjunction with the CONCAWE meteorological

correction. As stipulated, both use the ISO-9613-2 propagation standard but without the ISO meteorological correction (Cmet). Instead, the CONCAWE approach adds a meteorological correction that is used in the original CONCAWE propagation standard to the hourly calculation of ISO-9613-2 components for estimates of long-term sound impacts.

Q. Are the ISO-9613-2 input values and assumptions the same for both methods.

A. No, they are not. The formulas are similar but the input values and assumptions used in the studies are different. The ISO 9613-2, for estimates of maximum short-term noise levels, is calculated with a ground factor G 0.5 but uses a ground factor of G 1 when used in conjunction with the CONCAWE meteorological correction for long-term estimates. In simple terms, a G factor of 1 represents a better ground effect that results in lower noise levels. Initially, the CONCAWE meteorological correction is calculated, which can be either positive or

negative. In other words, it can be added or subtracted to the ISO 9613-2 calculation components in an hourly basis. Further calculations based on 8,760 hours in a year are conducted to arrive to an estimate of the long-term energy-based average sound level Lnight at a particular receptor. The CONCAWE meteorological corrections can be either positive or negative because there are atmospheric conditions that are favorable and others that are unfavorable for propagation of noise. In other words, it may increase or decrease the sound levels at a particular receptor.

Q. What is the issue with the estimates of long-term sound levels?

A. The problem is that in the Application, for every hour that the sum of the ISO-9613-2 with G=1 , and the CONCAWE meteorological correction exceeds the sound levels estimated with the ISO-9613-2 standard with G=0.5, and maximum sound power levels, a correction is applied to match

the ISO-9613-2 results. In other words, this is done so that the level never exceeds the ISO-9613-2 short-term estimates.

Q. Is this approach reasonable?

A. In my opinion it is not. I have not found any peer reviewed publication or standard that calls for this. The correction also seems to be based on the Application's assumption that predictions of the 1-hour-Leq sound levels with the ISO 9613-2 and no meteorological correction (Cmet) correspond to the maximum sound levels that can actually be measured but, as I will explain, the MA-Study contains evidence showing that this is not the case. For one out of six 1-hour-Leq samples (and one of the two highest) the measurements exceeded the predictions by three decibels. Therefore, regardless of the assumptions and input values used in the CONCAWE calculations, corrections should not be applied to reduce the predictions with the CONCAWE to match the ISO-9612-2 G=0.5 calculations because, as the evidence supports, the actual measured

sound levels can be higher than the estimates achieved by using computer noise modeling.

Q. What is the evidence contained in the MA Study?

A. In my review of studies concerning accuracy of the ISO-9613-2 model I found one where the use of the ISO-9613-2 sound propagation model with similar assumptions and input values to the ones that were used in the Application, resulted in about a 3-dBA underprediction of the Leq-1-hour noise descriptor for one out of six 1-hour samples and one out of the two highest sound pressure levels that were modeled and measured.

Q. What is the study you refer to and which is the section that shows the underprediction?

A. The study is entitled "Massachusetts Study on Wind Turbine Acoustics" (Exhibit MMC-5) which was prepared for the Massachusetts Clean Energy Center and Department of Environmental Protection. The findings relevant to this case are shown on Figure 26, page 68, and is included as Exhibit MMC-6. The figure has three graphs and the one at the bottom shows a correlation

between sound pressure levels estimated at a receptor located 330 meters (1,083 feet) downwind from the turbines as obtained with the ISO-9613-2 sound propagation model and a ground factor of G 0.5 plus a 2 BA correction added to the results. The figure correlates the estimates to the sound pressure levels that were measured after monitoring the 1-hour Leq-dBA noise descriptor for six hours at that receptor. This can easily be observed in Exhibit MMC-6 where I have included my notes on top of the relevant graph. As it can be seen from the graph (Exhibit MMC-6) in one out of the six hours, the sound pressure levels using computer noise modeling were 3 dBA lower than as measured after monitoring (43 dBA as opposed to 46 dBA). The 3-dBA underestimate occurred for one of the two highest sound pressure levels. This also shows that although the addition of 2 dBA to the ISO 9613-2 results improves the accuracy of the estimates, it is not sufficient for one out of two samples at the maximum sound power levels.

In this case a correction of 5-dBA and not 2-dBA is needed to estimate the actual maximum 1-hour sound levels.

Q. You mentioned earlier in your testimony that the Massachusetts Study (MA-Study) used the same or similar input values to the ones used for Baron Winds. What are the differences and how are those differences relevant to this case?

A. There are two differences. The first is that the receptor in the MA-Study was evaluated at 330 meters (1,083 feet) from the turbine but the setbacks for Baron Winds are 1,000 feet for participating receptors and 1,500 feet for non-participating receptors. Despite the differences, the findings are still applicable to this case. In fact, I would expect that the discrepancies would grow for receptors at distances greater than 330 meters (1,083 feet) and not decrease. The second difference is that the MA-Study evaluated sound receptors at 1 meter above the ground while the Application evaluated receptors at 4 meters above the

ground. I estimate that the predicted sound levels at 4 meters may be higher (about 1.5 dBA for the closest receptors) but still insufficient to compensate entirely a 3 dBA underprediction. In addition, the MA-Study did not evaluate receptor at 4 meters which may be appropriate for two-story houses and therefore it is unknown whether the 3-dBA underprediction also occurs at 4 meters.

Q. Can such exceedance be mitigated after the Project becomes operational?

A. Yes, a 3 dBA underprediction can be mitigated by applying NRO's on the closest turbine(s).

Q. If it can be mitigated by applying NRO's what is the concern?

A. The concern is that the redesign already uses noise reductions equivalent to 5 dBA on five turbines, 4.5 dBA on one and 4 dBA on three and for those turbines the room to increase the noise reductions further is limited and that will reduce power production as well. For those wind turbines, the only mitigation option would

be a shutdown for the periods when the sound limits are exceeded. In addition, the Applicant has not proposed a Certificate Condition to measure the Lnight descriptor after construction and its evaluation is not found in the postconstruction protocol either.

Q. Is there any other assumption or correction you disagree with?

A. Yes, the application of random numbers to the estimates of hourly sound levels at a particular receptor. I disagree with the generation and introduction of random numbers to the calculations for different reasons: first, they are in my opinion unnecessary; second, they introduce distortions to the results; third, they make the calculations un-replicable; and fourth, results may be different depending on the specific random numbers that are generated. In addition, I have not found any standard or guidelines written by other authors that recommend the generation of random numbers to be introduced in the calculations of computer noise

sound levels at receptors.

Q. Any other concerns?

A. Yes, if the intent of the introduction of random numbers is to replicate transient changes in sound levels that may occur by changes in propagation conditions due to temperature or weather changes, this may not be in line with the requirements of Exhibit 19(d), 16 NYCRR §1001.19(d), that requires an applicant to ignore any attenuation of sound that result on transient changes of weather and temperature.

Q. If no corrections are applied to match the results obtained with the CONCAWE to the ISO-9613-2 and if random numbers are not generated what would be the sound results of the Lnight noise descriptor.

A. From the information included in the Supplement, including corrections and NRO's and turbine elimination, seven sound receptors will be impacted in the cumulative analysis: five with an Lnight of 41 dBA, one at 46 dBA and another at 51 dBA. No information is included for the

Lnight without corrections and NRO's applied in a cumulative basis.

Q. You mentioned earlier in your testimony that you disagree with applying corrections to the CONCAWE approach to match the ISO-9613-2 results and the introduction of random numbers. What is your opinion about the calculation with CONCAWE meteorological corrections presented in the Application?

A. The raw data without any corrections, showed for the original design, 1-h-Leq sound levels 1 to 2 dBA above the ones predicted with the ISO-9613-2. I believe the unadjusted data results are closer to the maximum 1-hour Leq levels. The review of calculations of long-term estimates is complicated. [redacted]

I consider it is important to analyze whether the differences make sense and also analyze what the short-term sound limit should be so that the Lnight could be met. One of the most practical

approaches is to make an estimate of the Lnight based on the difference between the maximum 1-hour sound power level generated by a turbine in a year and the yearly energy-based average of all sound power levels generated by the same wind turbine in a year based on the statistics of wind direction for a site and the turbine selected for a project. Basically, this acknowledges that the main factor for the generation of noise is the wind magnitude at the hub height and ignores other variables that may affect the sound levels at a receptor such as wind direction and cloud coverage during the nighttime.

Q. Is this a valid assumption?

A. Yes. NARUC-2011 reports that wind turbine noise is not directional. This means that the sound levels are similar regardless of whether the receptor is located upwind, downwind, and cross wind conditions.

Q. What specifically does NARUC-2011 say?

A. "The assumption of an omni-directional wind

means that the sound power level of the turbine, which is measured in the IEC 61400-11 procedure downwind of the unit, is modeled as radiating with equal strength in all directions; i.e. the sound level in every direction is the downwind sound level. Although this may seem be depict an unrealistic situation and over-predict upwind sound levels, the fact of the matter is that this approach generally results in predictions that are consistent with measurements irrespective of the where the receptor point is located. Although somewhat counterintuitive, the reason for this is that wind turbine noise under most normal circumstances is not particularly directional and generally radiates uniformly in all directions. As an example, the plot below shows the sound levels measured in three directions 1000 ft. from a typical unit in a rural project in [s]outhern Minnesota. Although there are periods when the levels differ, implying some directionality, the majority of the time all three sound levels are generally

about same irrespective of the wind direction. Moreover, the sound level at the downwind position is almost never elevated relative to other directions as one might expect."

Q. Please explain what this means.

A. A receptor is downwind if the wind is blowing and reaches the turbine before reaching the receptor, in other words, the wind blows from the turbine to the receptor. Upwind is the opposite, the wind reaches the receptor first and the turbine after, in other words, the wind blows from the receptor to the turbine. Crosswind is when the receptor is not located downwind or upwind from the noise sources, in other words, the wind blows in a way that can reach the turbine or the receptor at the same time or one of the two first, but not the other. In the original CONCAWE method, receptors located downwind from the noise sources are supposed to have greater sound levels than the receptors located on the other side of the turbine (upwind). Receptors upwind are supposed

to have lower noise levels and receptors located crosswind are supposed to have sound levels between those calculated for receptors located downwind and upwind from the turbines. But, as described in NARUC-2011 and other publications, for receptors very close to the turbines this does not seem to happen.

Q. Are you criticizing the CONCAWE method that was stipulated?

A. No, I am objecting to the way that it was applied, by adjusting sound levels so that they do not exceed the ISO-9613 method, which will have the effect of reducing, not increasing, the results. A better practice would have been not introducing any adjustment, or if adjustments were introduced to decrease the maximum levels, they should also have been introduced to increase lower sound levels.

Q. Why do you think this does not happen?

A. As described by the NARUC-2011 guidelines, one of the reasons may be because wind turbine noise is not quite "directional" at all frequency

bands. For instance, low frequency noise propagates in all directions, not in a single direction. The other reason could be that the CONCAWE Standard was developed based on three Petrochemical plants where receptors are located either downwind, upwind or crosswind from the plants. For wind turbine noise, especially if a receptor is surrounded by several turbines, a receptor could be simultaneously located downwind from some turbine(s) and upwind or crosswind from other turbine(s).

Q. Do other references indicate that the difference between downwind, upwind and cross wind conditions may be minimal for the most impacted receptors, closest to the turbines?

A. Yes. The MA-Study, Figure 20, shows sound levels for a receptor located at 330 meters (1,083 feet) from the turbines and the results are basically the same: many data points present both underpredictions and overpredictions and, for that reason, they locate on both sides of the diagonal that represents a perfect match.

Although upwind data shows more deviation with respect to the center line than the crosswind and downwind condition, they all occur on both sides of the diagonal line. I should note that the addition of 2-dB was needed for all wind directions and not for downwind conditions exclusively, to improve the accuracy between predictions and actual noise measurements.

Q. Do any other references address this issue?

A. Yes. The Institute of Acoustics in the publication entitled: "A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise," dated MAY 2013, section 4.4.2. on page 22, states: "Based on evidence from the Joule projectv[iii] [[iii] Wind Turbine Noise, Dick Bowdler and Geoff Leventhall (Eds). Multi-Science Publishing Co Ltd (2011)] in conjunction with advice in BS 8233 and ISO 9613-2, current practice suggests that for a range of headings from directly downwind (0°) up to 10 degrees from crosswind (80°), there may be little to no reduction in noise levels…." Figure

6 on the same page also shows that for receptors located within 5.25 times the tip height of the turbine (2,584 feet in this case based on the turbines proposed for this Project) the sound levels downwind and upwind are basically the same and for the cross wind condition there may be a difference of 2 dB in a narrow angle of only 20 degrees out of 180.

Q. What are the results and the implications?

A. This shows that what may be most important is the wind magnitude only, not the wind direction. Other factors such as solar radiations do not play any role for calculation of the nighttime sound levels and may play only a minor role during the daytime. Cloud coverage may also play a minor role when the turbines are producing low noise emissions and may not modify the results at wind speeds greater than the cut-in speed. Several meteorological categories are only relevant when the turbines are not rotating and for that reason they do not play any role in the calculations.

A. Based on the statistics of wind speed for the Project, excluding all irrelevant factors and meteorological conditions that may play a minor role, and for the two turbines selected for this Project, I find the following: [redacted]

Q. What are the results for the GAMESA turbine?

A. [redacted]

Q. Since the Project as recently supplemented includes both turbines in the layout, what would the conclusions be in this case?

A. My recommendation is that the regulatory limits

should be based on the most protective results for the two turbines that were analyzed so that the WHO guidelines of 2009 are met with any of the two turbine models.

Q. How do your results compare with your recent testimony for Eight Point Wind?

A. Although the wind speed statistics and the turbine models used for the Project are different in that case, the conclusions are similar. For that project I recommended a maximum short-term noise level of 42 dBA-Leq-8-hour.

Q. If for some reason an Lnight of 40 dBA is exceeded at a particular receptor, is it possible to provide mitigation?

A. Yes, but as I explained before, there are twenty-eight turbines where NRO's were applied: five turbines where an NRO of 5 dBA was used, one where an NRO of 4.5 dBA was used, and six where a 3 dBA NRO were used to demonstrate conformance with relevant criteria through computer noise modeling. Without those NRO's in

the model and if turbines T1, T72 and T74 are not eliminated, the results will show that more receptors will exceed the Lnight.

Q. Are there any other concerns?

A. Yes, the NRO's are more effective if they are needed to reduce exceedances to a short-term noise limit rather than a long-term limit. In fact, when a short-term limit is exceeded, the NRO will only need to be applied during the periods of times when the short-term sound levels are exceeded, most likely at the highest sound power levels of generation. But for long-term sound limits this works differently.

Q. Please explain.

A. Noise Reduction Operations are more effective at high wind speeds, but they could be zero at medium and low wind speeds. Therefore, the noise reduction achieved at the receptor is lower than the noise reduction applied on the turbines. For instance, if a 2-dBA noise reduction is needed at a receptor a higher NRO would need to be applied on the closest turbines (e.g., 3 dBA).

If the NRO is applied only to one turbine and not to other closer turbines the NRO may need to be even higher.

Q. Why is that significant?

A. This is another cause of concern specially because although the long-term limits that were imposed by the Siting Board in the Cassadaga Wind case are included in the Certificate Conditions proposed by the Applicant for Baron Winds, evaluation of the Lnight descriptor is not included in the protocol for post-construction evaluations. What this also means is that if the long-term sound levels are only modeled by computer, there will be no measurements to demonstrate whether the Facility exceeds the long-term recommendation of 40 dBA Lnight from WHO-2009.

A. Is there any other alternative?

Q. Yes. One alternative is to require the Applicant to measure the Lnight as the Siting Board did for Case 14-F-0490 and also measure the Lnight as I have proposed in the DPS-Protocol.

Alternatively, the long-term limits may be eliminated from Certificate Conditions and post-construction compliance measurements provided a lower short-term limit is adopted and NRO's are not used in computer noise modeling. Since NROs are only effective at high wind speeds and may not be applied to all relevant turbines, this short-term regulatory limit should be conservatively estimated.

Q. Do you have a recommendation about what that limit should be?

A. Yes, the limit should be 42-dBA-Leq-8-h or lower.

A. Do you have any other concerns about the long-term impacts from the proposed Facility other than those mentioned for the nighttime long-term Lnight noise descriptor?

A. Yes. The World Health Organization released new guidelines in October of 2018, after the Application was filed, with specific recommendations to address wind turbine noise and with potential implications that I consider

important to be considered by the Siting Board.

Q. What are the most important findings from your review of WHO-2018 as related to this Project?

A. As mentioned before, one of the most important findings is that WHO-2018 withdrew the outdoor short-term recommendation of not exceeding 45 dBA-Leq-8-hour during the nighttime that it had recommended in 1999. WHO-1999 was the basis for recommending the Siting Board to apply this short-term limit to the Cassadaga Wind project in Case 14-F-0490. In addition, WHO-2018 (p. 9) recommends a lower outdoor-to-indoor noise reduction provided by the residential buildings than the one that was assumed in 1999 for transportation noise sources, as well as maintaining the indoor noise levels as recommended in 1999. Furthermore, the new recommendation from WHO-2018 is protective not only of the nighttime period but of the daytime and evening time periods as well and more importantly it may require a lower short-term and long-term nighttime noise limit than as

recommended in 1999 and 2009, which was also the basis for recommending the Siting Board adopt a short-term and long-term limit for Cassadaga Wind. After analyzing the recommendations of WHO-1999, WHO-2009, and the WHO-2018 independently, I conclude that the short-term 45 dBA-Leq-8-h outdoor limit is not the most protective among all three guidelines and that a lower limit, on the order of 42-dBA, should be adopted so that all three WHO guidelines and recommendations are met and that the potential adverse effects from the Facility are minimized.

Q. You mentioned at the beginning of your testimony that you were introducing the new WHO-2018 guidelines as an exhibit in your testimony for this case. Please explain why this is important.

A. Yes, the new guidelines propose the Lden noise descriptor which considers the daytime, evening time, and nighttime noise levels.

Q. Do those guidelines specifically address the potential health impacts from wind turbine

noise?
A. Yes. The guidelines include consideration of Wind Turbine Noise.
Q. What are the findings?
A. The WHO-2018 guidelines found that adverse health effects (such as annoyance) are associated with a level equivalent to 45 dBA Lden. Therefore, the recommendation is that sound levels from wind turbines should be lower than 45-dBA Lden in a year.
Q. What is the Lden?
A. The Lden is another noise descriptor equivalent to a yearly energy-based average with no penalties applied to the daytime period, a 5-dBA penalty applied to the evening period, and a 10-dBA penalty applied to the nighttime period.
Q. How are the daytime, evening time and nighttime periods defined?
A. The definitions for all these periods of time in a day may be different for Europe, the United States, and other countries. For example, the "nighttime period" in Europe spans from 11 p.m.

up to 7 a.m. the following morning, or from 10:00 p.m. to 6:00 am the following day (8-hour), while in United States "nighttime period" spans from 10 p.m. up to 7 a.m. (9-hour). In addition, the "daytime period" in Europe spans from 7 a.m. up to 7 p.m. or from 6:00 a.m. to 6:00 p.m. (12-hour) (WHO-2018, p. 9) while in United States "daytime" spans from 7 a.m. to 6 p.m. (11-hour). The "evening time" in Europe goes from 7 p.m. to 11:00 p.m. or from 6:00 p.m. to 10:00 p.m. (4-hour) while in the United States "evening time" spans from 6 p.m. up to 10:00 pm. Despite the differences in timing definitions, the Lden noise levels for both may result in numbers that are quite similar with differences in the order of a few decimal points.

Q. If a sound source is constant during the day time, evening time, and nighttime (as defined in the United States), how many decibels should that noise source be in order not to exceed the 45-dBA Lden recommendation?

A. That sound source should have a constant average sound pressure level lower than 38.2 dBA Leq during the daytime (Lday), evening time (Leve), and nighttime (Lnight) in a year so that after all the penalties are applied it does not equal or exceed the 45 dBA Lden WHO-2018 recommendation. In other words, the daytime, evening time, and nighttime average sound exposure in a year should be about 6.8 dBA lower than 45-dBA Lden WHO-2018 or equivalently 38.2 dBA.

Q. Are there any other corrections to be applied?

A. Possibly. For instance, it is technically feasible to include the periods of time when the noise sources are not generating noise in the calculation of the Lden in a year. The effect of not including any noise from the noise sources (wind turbines in this case) during these periods depends on the percentage of the year the turbines are not producing noise, but they may result in an extra allowance that could be approximately 0.9 dBA for a noise source that

is not generating sound for approximately 10% of the time in a year. That being said, the sound should be lower than 39.1 dBA for the yearly average of the Ldaytime, Levening, and the Lnight (38.2+0.9=39.1). These levels, when combined with the percentage of time that noise source is not generating noise and after the 5 and 10-dBA penalties are applied to the evening time and the nighttime (respectively), will result in a Lden of 45 dBA.

Q. How does a noise level of 39.1 dBA Leq in a year equate to a maximum short-term threshold such as the Leq-11-hour (daytime), 4-hour (evening time), 9-hour (nighttime).

A. As explained before, the difference between the long-term Lnight descriptor and the maximum short-term noise descriptor (such Leq-1-h or 8-h) depends on the statistical distribution of wind speed magnitudes at the site and the turbine model selected for the Project. Assuming that the difference is 2 dBA, a 39.1 dBA average in a year during the daytime would

approximately equate to a short-term level of 41.1 dBA Leq during the daytime. For a noise source that is constant in time the average for the daytime and evening time periods should be the same. Therefore, in my opinion, the regulatory short-term limit for the daytime and evening time should be about 41 dBA so that the 45-dBA Lden recommendation is met.

Q. These are estimates for a noise source that is constant in time. Are they applicable to wind turbine noise that is not constant in time?

A. Yes, they are. The Netherlands has regulations that use the Lden and the Lnight noise descriptors. The limits have been set at 47-dBA Lden and 41-dBA Lnight since 2011, a difference of 6 dBA between the two noise descriptors (See, Wind Farm Noise Measurements Assessment and Control Colin H. Hansen, Con J. Doolan and Kristy L. Hansen. p.41. Wiley. 2017). For Baron Winds, the difference between the sound power level that generates the Lnight and the Lden in a year is 6.6 dBA for both turbines proposed for

the Project, similar to the 6 dBA assumed in the Netherlands.

Q. What are the implications in this case?

A. [redacted]er [redacted]

[redacted]

Q. If the new WHO-2018 recommendation is exceeded can that be mitigated and, if so, how?

A. Yes, the exceedance could be mitigated by applying NRO's to the closest turbines or eliminating some from the design. If NRO's are applied, they need to be greater than the noise reduction needed at the receptor but, as explained before, for the turbines where the maximum NRO of 5 dBA was already used in computer noise models to demonstrate conformance, there may be low or no additional

room for increasing the NRO's.

Q. How many receptors may exceed a short-term sound limit of 42 dBA-Leq-1-h with and without the application of NRO's in a non-cumulative basis?

A. With NRO's applied to the model there are about 30 non-participating receptors and 3 non-participating cabins with short-term levels exceeding a 42-dBA-Leq-1-hour sound levels. Without NRO's there are about 77 non-participating receptors and 5 non-participating cabins exceeding that threshold.

Q. How many receptors may exceed a cumulative short-term sound limit of 42 dBA-Leq-1-h with and without the application of NRO's?

A. With NRO's applied to the model there are about 55 non-participating receptors and 4 non-participating cabins with cumulative short-term levels exceeding a 42-dBA-Leq-1-hour sound level. Without NRO's, there are about 90 non-participating receptors and 5 non-participating cabins exceeding that threshold.

Q. Do you have any recommendations for

Participating receptors?

A. Yes. For Cassadaga Wind, Case 14-F-0490, the Siting Board imposed Certificate Condition 70(d)(ii) limiting the long-term noise levels to 50-dBA-Lnight as a compliance filing requirement and on the assumption of a 5 dBA difference between long-term and short-term descriptors imposed a Certificate condition requiring post construction noise measurement to demonstrate that the sound levels do not exceed 55 dBA-Leq-8-hour. On the basis that the difference between those descriptors may be 2 dBA and not 5 dBA, I advise that the short-term limits at participating residences and any portion of land on non-participating property be limited to 52 dBA-Leq-8-h.

Q. How many participating receptors exceed a sound limit of 55 and 52-dba-leq-8-hour?

A. With the current design, no participating receptor and no non-participating property line are forecasted to exceed 55-dBA Leq-1-h with or without NROs in a cumulative or non-cumulative

basis. One participating receptor is expected to exceed 52-dba if no noise reductions are applied in a cumulative and non-cumulative basis. This seems to be caused by Baron Winds, not the Cohocton facility. Only one boundary line is reported to exceed 52 dBA in a cumulative analysis if NROs are not applied.

Q. What are the results of impacts from low frequency sound?

A. The Application identified 65 dB as a goal for low frequency sounds at the full octave bands of 16, 31.5 and 63 Hertz. Only one receptor, a non-participating cabin, is reported to be exposed to 66 dB at 16 Hz. However, that does not mean that the potential low-frequency impacts have been minimized to the maximum extent practicable.

Q. Please explain.

A. The Application Supplemental PNIA states: "Since Gamesa does not published [sic] 1/1 or 1/3 octave band noise reduced operation (NRO) data for this turbine, the maximum sound power was

shifted down to correspond to the desired amount of sound level reduction when NROs were required." What this means is that this information may not be available and for that reason it was estimated by reducing all sound power levels at all frequency bands by the same number of decibels. In other words, if an overall NRO of 5 dBA was needed, all sound power levels at all frequency bands of the spectra were assumed to be 5 dB lower.

Q. Is this correct?

A. No. An NRO may be effective to reduce overall broadband noise levels but not low frequency sound levels. This may result in underestimates of the low frequency noise impacts at sensitive receptors. I have seen that on manufacturer's data for some turbines and found that this also was discussed by another author. In fact, Frits van der Berg in his article "Wind turbine noise: an overview of acoustical performance and effects on residents," states: "As is shown in Figure 6 for one particular turbine, this

effectively reduces broad band A-weighted levels, but does not have much influence on the low frequency (<=125 Hz) octave bands" (Australian Acoustical Society. Proceeding of Acoustics 2013. 17-20 November, Victor Harbor, Australia). From Figure 6 it can be seen that the difference in noise levels at the 63 Hz full octave bands are basically the same, in other words, the noise reduction at the 63 Hz band from NRO from 1 dBA to 6 dBA is practically nothing. For the 16 Hz, which is typically the most problematic, the noise reduction can be practically zero.

Q. What are the implications?

A. There are 71 non-participating receptors where low-frequency noise levels are forecasted with sound levels equal to or greater than 61 dB in the non-cumulative assessment and 95 receptors exceeding 61 dB at 16 Hz in a cumulative assessment. Some of those receptors are located close to the GAMESA turbines and for those receptors the low frequency impacts may be

underestimated, which means that they may exceed a 65 dB threshold at 16 Hz. The Supplement already uses up to 5 dBA NRO's for some Gamesa turbines where the sound levels for low frequency bands were reduced by 5 dBA although the proper reduction may be zero.

Q. How can this problem be solved?

A. The same Certificate Conditions on low frequency sounds imposed by the Siting Board in Cassadaga Wind, Case 14-F-0490, should be adopted for this Project consisting of modeling with the final turbines proposed for the Project and measuring low-frequency sounds after the Project is built. The computer noise modeling should be updated to reflect the actual sound information from the manufacturer during compliance filings. Should computer noise modeling show exceedances, mitigation of low frequency sound levels should be explored during the design phase. This may consist of replacement of turbine models as needed or turbine elimination.

Q. Can a turbine replacement solve the problem?

A. Yes. I have seen manufacturers' information that showed that a model option with serrated edges was capable of providing noise reduction at low frequency bands.

Q. Please explain what is the first issue that you find in the Certificate Conditions proposed by the Applicant for Baron Winds?

A. For Cassadaga Wind, the Siting Board imposed Certificated Condition 80, with a short-term sound limit of 45 (dBA) Leq (8-hour) at any permanent or seasonal non-participant residence and 55 dBA Leq (8-hour) nighttime for any participant residence existing as of the issuance date of the Certificate. In contrast, in Certificate Condition 76, proposed by the Applicant for Baron Winds, the limits apply to the nighttime period exclusively, not for any other time of the day as imposed for Cassadaga.

Q. Do you agree with that change?

A. No, I do not. As discussed in Case 14-F-0490, I advise that the limits should be applied to the daytime and nighttime for several reasons.

First, a Certificate Condition for the nighttime exclusively has no precedent under Article 10, Article X, and Article VII Orders. Second, a Certificate Condition exclusive for the nighttime would leave, without any basis, the application of tonal and Amplitude Modulation penalties for the daytime, which are, in addition to the noise levels, contributing factors for annoyance. Third, having no restrictions on noise for the daytime may potentially result in situations where NRO's may be applied to comply with nighttime limits exclusively, but not during the daytime period as well. Fourth, although the recommendation was based on a night limit for the nighttime provided by WHO-1999 (Exhibit MMC-1), the most recent recommendations from WHO (WHO-2018, Exhibits MMC-3 and MMC-4) uses a noise descriptor that includes consideration of all time periods in a day, not the nighttime only.

Q. Has the Siting Board made a determination on this issue?

A. Yes, in Case 14-F-0490 the Siting Board imposed the 45 (dBA) Leq (8-hour) sound limit regardless of the time of day or night which means that the limit shall not be exceeded during any eight consecutive hours during the day.

Q. Are there any other issues with short-term goals as related to proposed Certificate Condition 76?

A. Yes. The Applicant for Cassadaga Wind initially presented two different goals, one for full-year or permanent residences and another for seasonal residences that was three decibels greater. Staff's position in that case was that the limits should be the same regardless of occupancy, which was imposed as Certificate Condition 80 specifying that the limit applies to both seasonal and permanent residences. Such language is excluded from the text of the proposed Certificate Condition 68 for this case and should be incorporated as is currently included in the recommended DPS Certificate Condition 72 (a).

Q. What is the next issue that you find with the

certificate conditions proposed by the Applicant?

A. As explained earlier in my testimony, although the Siting Board imposed in the Cassadaga Wind Case 14-F-0490 Certificate Condition 80(b) with a long-term limit of 40 dBA Lnight at any non-participating residence and 50 dBA Lnight at any non-participating residence, those limits are excluded from the Certificate Conditions proposed by the Applicant for Baron Winds. In addition, evaluation of the Lnight descriptor is not included in the protocol for post-construction evaluations. What this means is that there will be no measurements to demonstrate whether the Facility exceeds the long-term recommendation of 40 dBA Lnight from WHO-2009 and the limit of 50 dBA Lnight for participating receptors, which was based on the identified threshold for zero risk of cardiovascular disease identified by WHO-2009. The condition has been included in Staff Certificate condition 72 (b).

Q. Are there any issues related to low frequency sounds from the wind turbines in the Certificate Conditions proposed by the Applicant?

A. Yes. In Case 14-F-0490 the Siting Board adopted Certificate Condition 80(c), which requires the facility to "[c]omply with a maximum noise limit of 65 dB Leq at the full octave frequency bands of 16, 31.5, and 63 Hertz outside of any non-participant residence existing as of the issuance date of this Certificate in accordance with Annex D of ANSI standard S12.9-2005/Part 4 (Sounds with strong low-frequency content)." That condition is not proposed by the Applicant for Baron Winds.

Q. What does Annex D of ANSI Standard S12.9 say?

A. Section D.2 of Annex D in ANSI S12.9-2005 Part 4, entitled “Sounds with strong low-frequency content,” states “[g]enerally, annoyance is minimal when octave-band sound pressure levels are less than 65 dB at 16, 31.5 and 63-Hz mid-band frequencies.”

Q. What is your recommendation for this case?

A. A Certificate Condition for low frequency noise is protective of annoyance to low frequency sounds and perceptible vibrations and for that reason should be adopted for Baron Winds as it was for Cassadaga Wind. This is reflected in DPS-Staff proposed Certificate Condition 72(d)

Q. Are there any issues related to Certificate Conditions proposed by the Applicant as related to complaints from the wind turbines?

A. Yes. In Case 14-F-0490, the Siting Board adopted Certificate Condition 81, which has different requirements for the facility related to the way that noise and vibration complaints should be handled. These provisions are not found in the Certificate Conditions proposed by the Applicant for Baron Winds. These provisions are included in DPS Staff's proposed Certificate Condition 73 for this Project.

Q. What is the importance of this Certificate Condition?

A. All these conditions are very important, particularly Certificate Conditions designated

as 81(c) and 81(d) in the Cassadaga Wind Project, because they relate to the way complaints from Amplitude Modulation are handled. Amplitude Modulated sounds from wind turbines and how they increase annoyance to sounds from Wind Turbines was thoroughly discussed in the Cassadaga case. In that Case, the Siting Board adopted the recommendation from DPS Staff and imposed a Certificate Condition for AM with a 5 dBA AM penalty. Given the importance of having requirements for the Facility to handle complaints, Staff is proposing for Baron Winds the provisions adopted by the Siting Board for Cassadaga Wind to handle complaints, including those related to Amplitude Modulated sounds along with some modifications that I will discuss later in my testimony.

Q. Please explain the concept of amplitude modulation and the Application's analysis and conclusions related to amplitude modulation.

A. In simple terms, amplitude modulation is a repetitive sound that occurs with a frequency of

about one second or less. This is commonly described as a repetitive "swish" or "thump" associated with turbine operation. "Recent evidence suggests that at times this 'swish' can become more of a pronounced 'thump,' leading to complaints from wind farm neighbors." "(UK-2016, p. 1)."

Q. Are there any differences between Certificate Conditions proposed by Staff and the Applicant as related to complaints from Amplitude Modulation (AM) from the Project?

A. Yes. Given the discrepancies that could occur between computer noise modeling and actual post-construction noise measurements, I recommend that complaints related to Amplitude Modulation be investigated if measured or modeled sound levels at the location(s) being evaluated exceed 40 dBA L1hr, rather than based on modeled levels exceeding 40 dBA L1hr exclusively, as ordered for Cassadaga Wind (Certificate Condition 81 (d)). That change is reflected in Staff's Certificate Condition 73 (d). In addition, I

recommend edits on the clause related to Amplitude Modulation as ordered for Cassadaga. The edits are consistent with the discussion on page 60 of the Cassadaga Wind Order that states "[t]he RD also adopted a restriction on the Facility's production of amplitude modulated sounds, such as complaints of swishing or thumping type sounds. Should such amplitude modulated sounds be found to exceed a noise level of 45 dBA for more than 5 percent of the evaluation period, the Certificate Holder would be required to implement minimization measures."

Q. Are there any issues related to the Applicant's proposed certificate condition on Amplitude Modulation?

A. Yes. I consider that the time frame of evaluation of Amplitude Modulation should be clearly specified. I am proposing a timeframe of evaluation of 8-hours which I consider to be appropriate. The text "amplitude modulation depth is 5 dB or lower for a minimum of 90% any hour" is confusing. First, I think that the 90%

was set as the complement of the 10% indicated in the same clause. Therefore, the 90% should be 95%. Second, the text should refer to the penalty for Amplitude Modulation which is set at the beginning of the same clause. For that reason, I am proposing edits so that the Application of the AM penalty makes sense and is consistent with the intent expressed in the discussion of the order and the first portion of this clause.

Q. Is there any other way to address potential issues with amplitude modulation sound?

A. Yes, by reducing the sound limits to which the AM penalty is applied. The UK-2016 document recommended amplitude modulation penalties between 3 and 5 dBA. The 3 dBA penalty is applied if an AM depth of 3 dBA occurs while a 5 dBA penalty is applied if an AM depth greater than 5 dBA occurs. If the short-term goals and limits are reduced to 42 dBA or lower an amplitude modulation penalty may not be needed.

Q. Are there any advantages when doing this?

A. Yes. There is no need to measure amplitude modulation. Therefore, Certificate Condition 73 (d) could be eliminated as proposed in my alternative to Certificate Conditions in Exhibit__(MMC-10). As I previously stated, the short-term limit should be equal to or lower than 42 dBA to meet the WHO recommendations of 1999, 2009, and 2018 and, at that level, the AM penalty may no longer be necessary.

Q. Do you have any recommendations about how complaints should be reported?

A. Yes. My recommendations are reflected in Certificate Condition 73(c), Exhibit__SSP-2. For this case I recommend that complaints be reported monthly during the first three years of operation and quarterly after that rather than monthly during the first full year of commercial operations as adopted for Cassadaga. If no noise or vibration complaints are received. I also recommend requiring the Certificate Holder to submit a letter to the Secretary indicating that no complaints were received during the

reporting period rather than excepting the Applicant of any filings if no noise or vibration complaints are received.

Q. Do you have any recommendations for Compliance testing?

A. Yes, I do. In Case 14-F-0490, the Siting Board adopted Certificate Condition 72 requiring the Applicant to perform two compliance tests: one during "leaf-on" conditions; and another one with "leaf-off" conditions. Those provisions are not proposed by the Applicant for Baron Winds. DPS Staff is proposing similar language in its recommended Certificate Condition 70. One of the changes Staff is requesting, as related to Certificate Condition 71 adopted for Cassadaga, refers to the Compliance Protocol. For Cassadaga Wind DPS Staff did not propose a compliance protocol. Absent of any alternatives the Recommended Decision (RD) and the Siting Board's Order adopted the protocol presented by the Applicant. The Applicant here has proposed addressing complaints and testing the Facility

with a protocol that was initially filed with the Application and that was recently modified in response to interrogatory request "Oehlbeck-IR-1". I have objections to the most recent protocol which are presented in Exhibit MMC-13 with side comments on the most relevant issues. This does not address the parts of a compliance protocol that should have been but that in my opinion are missed.

Q. What are the most important issues with the Protocol presented in the Application?

A. The most important issue is that the protocol presented with the Supplement only proposes testing of the short-term noise descriptor for the nighttime at non-participating receptors. Testing of the long-term noise descriptor Lnight, as imposed by the Siting Board in Case 14-F-0490, is excluded as well as testing during the daytime and testing at participating residences. In addition, testing of the low frequency noise levels, as ordered by the Siting Board in Case 14-F-0490, is also excluded from

the protocol. In addition, there are no provisions for measurement of Amplitude Modulation and perceptible vibrations.

Q. Are there any other issues with the compliance protocol?

A. Yes. Section 2.6.4 Data Analysis states: "For any one-hour period during which Turbine-plus-background sound levels exceed 45 dBA Leq, Background will be subtracted to determine the sound level attributable to the Project (Turbine-only level). The Background level is the adjusted Background Leq with a factor added for uncertainty according to ANSI S12.9 Part 3 Clause 7.3.". The introduction of the word "added" is not appropriate. ANSI Standard requires the addition of the uncertainty for the party that needs to demonstrate a violation (DPS in this case) and the subtraction of the uncertainty for the party that needs to demonstrate "compliance," in this case, the Certificate Holders. The way this provision is drafted, demonstration of compliance by the

Certificate Holder will be potentially easier and demonstration of violation by any other party including DPS harder. In addition, the uncertainty factors specified by ANSI S 12.9 Part 3 are greater if the time between the measurement of operational sound and background sounds is greater. The intent is to encourage both parties to measure background levels very close to the time when operational sound levels are measured so that background conditions are similar. The way this provision is written it can make demonstration of compliance by the Certificate Holders easier if measurements are delayed or taken later rather of sooner, which makes absolutely no sense. On the other hand, this clause will force other parties including DPS Staff to take readings very close to the measurement of operational noise levels but not the Certificate Holders.

Q. How do you recommend this be corrected?

A. The provision should include the addition of uncertainties for the party that needs to

demonstrate a violation (e.g., DPS Staff) and the subtraction of uncertainties for the party that needs to demonstrate conformance, in this case the Certificate Holder. From the analysis of certificate conditions on noise imposed by the Siting Board in Case 14-F-0490, it is clear that demonstration of compliance corresponds to the Certificate Holder's (See Case 14-F-0490, Certificate Conditions 71, 72(a), 72(b), 72(e), 81(c) and 81(d). Alternatively, this provision should be eliminated from the Protocol so that the results as determined by the Certificate Holder and DPS Staff are the same, provided any background measurements are taken no later than one hour before or after any shutdown. The latter approach is proposed in the Staff's Protocol.

Q. Do you have any other issues with the proposed protocol?

A. Yes. Section 2.5 Data Collection states: "The sound monitoring period will last at least two weeks or until at least 20 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 4 m/s ...". First, this provision refers to maximum sound levels since the protocol presented in the Application only proposes measurement of short-term impacts. For that purpose, a wind speed of 4 m/s is irrelevant. It only means that the turbines will be rotating at minimal noise production. Noise levels should be measured at the worst operational noise conditions which usually correspond to wind speeds greater than 4 meters per second (Wind turbines typically reach the maximum sound power levels at wind speeds greater than 7 meters per second). This provision may result in 40 operational 1-hour sound levels that do not correspond to the worst noise conditions and, therefore, are not appropriate for determination of the maximum noise impacts.

Q. Do you have any other issues with the proposed protocol?

A. Yes. Section 2.6.6.a states: "Tonal periods will be further screened to determine if the tonal sound is audible using Table 7 of ISO 387-7 (2005)". DPS-Staff has not been able to find the referred standard. The way that this issue was addressed in the protocol imposed by the NYS Public Service Commission in Case 10-T-0350 was by using the hearing thresholds for a 95% confidence level as specified by Kurakata-2005. In other words, sound levels exceeding these thresholds will be only audible for 5 percent of the people and inaudible for 95 percent of the people. This potentially restricts the application of a tonal penalty as adopted by the Siting Board for Case 14-F-0490. For that case, the Board adopted a 5-dB tonal penalty regardless of the time period of evaluation.

Q. Do you have any other issues and what is your opinion on the protocol presented with the Supplement on the Application?

A. There are more issues and they are indicated in Exhibit MMC-13. In general, I do not recommend

the adoption of the Protocol as presented in the Application as it will not properly evaluate whether the Facility as designed and as built will in fact avoid, offset, or minimize, the adverse environmental noise or vibration impacts upon the local community for the duration of the certificate.

Q. Do you have any issues with the Complaint Resolution Protocol?

A. Yes. Those issues are explained with side comments on the Complaint Resolution Protocol recently submitted Exhibit__(MMC-13).

Q. Are you recommending a Protocol for postconstruction noise evaluations?

A. Yes. I am proposing a different Protocol for demonstration of operational compliance developed for this Project. I am attaching a copy of the compliance protocol presented with the Application with my comments on some portions of the text.

Q. Please explain what is the next change that you recommend.

A. Certificate Condition 71 presented in the Application states: "The Certificate Holder shall perform sound monitoring and compliance protocols pursuant to the Baron Winds Sound Monitoring and Compliance Protocol submitted with the Application." I disagree with this condition. First, the Applicant and DPS Staff should not follow the protocol presented by the Applicant as this protocol is insufficient and contains many issues as discussed here and in Exhibit__(MMC-13). Second, I recommend that if the Siting Board decides to grant a Certificate to Baron Winds any post-construction monitoring should be conducted by following the Sound Testing Compliance protocol presented by DPS and attached to this testimony as Exhibit__(MMC-7).

Q. Do you have any recommendations for Compliance Filings?

A. Yes, I do. In case 14-F-0490 the Siting Board adopted Certificate Conditions 70(a) and 70(b), which require the Applicant to file final construction drawings indicating changes in

turbine locations or substation components, if any, and present GIS files, dimensions, proposed grading and elevations for turbines, and any mitigation measures adopted for the Substation Collector. These provisions are not presented by the Applicant for Baron Winds but are presented by DPS Staff in proposed Certificate Conditions.

Q. Are there any differences between the Certificate Conditions Staff is recommending for noise and vibrations and the Certificate Conditions proposed by the Applicant as related to Compliance Filings?

A. Yes. In Certificate Condition 68(c)(i) I am including edits to fix typos related to the standards used to report sound power levels from the turbines. In Certificate Condition 68(c)(ii) I am including edits to reflect that sound power levels should not exceed the final overall and full-octave band levels presented in the Application or any subsequent supplement. In Certificate Condition 68(d) I am recommending

that NROs not be used in the design, to demonstrate conformance with any limit imposed by the Siting Board as a compliance filing requirement. Also, in Certificate Condition 68(d)(i) and 72(b), I am recommending requiring the Applicant to evaluate the new recommendations from WHO-2018 consisting of noise levels lower than 45 dBA Lden. As an alternative to this, I am recommending lower short-term regulatory limits as shown in my alternate proposed Certificate Condition 72(a)in Exhibit__(MMC-10).

Q. Are there any issues related to sound limits at the boundary lines?

A. Yes. Certificate Condition 68(d)(iii) has been included to reflect the discussions in the Cassadaga's order which was not reflected in the final approved Certificate Conditions. In that case the Order states, on pages 71 and 73: "[a]rea of property to be measured … The Examiners explained that although the Applicant also agreed to adopt a long-term design goal of

50 dBA Leq-1-year for the nighttime period at all participant receptors' property lines, it applied that measure only to the portion of a real property plot that is within 150 feet of an existing roadway. The RD recommended that we impose the design goal as a regulatory limit across the entire property to preserve the enjoyment of the entire property…. We agree with Concerned Citizens and DPS Staff. Cassadaga Wind's 150-foot from a public roadway limit is arbitrary. Notwithstanding the lack of specificity in the experience that Cassadaga Wind relies on to support its position, we do not agree that such experience is relevant for the local community at issue in this case. Accordingly, we adopt the RD's recommendation." That recommendation is reflected in my proposed Certificate Condition 68(d)(iii). In addition, although the recommended decision refers to a 50 dBA (Lnight-outside) limit, I consider it more practical to express this requirement by using a short-term limit for this compliance filing at

boundary lines. That is because it is practical to generate sound contour drawings with the ISO model for boundary lines with the sound turbines at maximum power levels but not feasible to generate yearly noise contours with the CONCAWE meteorological correction. As explained in my discussions above, the difference between the Long-term Lnight and the short-term descriptor Leq may not be 5 dBA but rather as low as 2 dBA. For that reason, I recommend a short-term limit of 52 dBA Leq-8-hour for boundary lines as a compliance filing in my alternate Certificate Conditions included in Exhibit__(MMC-10), Certificate Condition 68(d)(iii).

Q. Do you have any other recommendations?

A. Yes. In the event that the final turbine model selected for the Project has manufacturer's data showing higher sound levels in the overall broadband (dBA) noise level and also at any key low frequencies (16,31.5 or 65 Hz), the re-evaluation of predictions and conformance with relevant guidelines, criteria, and goals should

also include the new data at the low frequency range in order to understand the anticipated impacts of the different turbine model(s).

Q. What is your conclusion about the analysis of short-term impacts and Certificate Conditions?

A. Short-term regulatory limits should be lower than those set for Cassadaga Wind and may need to be as low as 42-dBA-8-h-nighttime to comply with the indoor recommendations of WHO-1999, the Lnight recommendations of 2009, and the Lden recommendation of 2018. The levels should apply to all non-participating receptors regardless of occupancy. In addition, short-term limits should be set for the daytime, as well. These recommendations are reflected in Certificate Conditions 72(a) and (b) and in my alternate set of Certificate Conditions (Certificate Condition 72(a).

Q. What are your recommendations for participating receptors.

A. I also recommend reducing the regulatory limit for non-participating receptors, from 55 dBA as

ordered for Cassadaga Wind to 52 dBA-Leq-8-h on the basis that the difference between the short-term limits and the long-term limits may be as low as 2 dBA and not 5 dBA as assumed for Cassadaga. This recommendation is based on an identified threshold of 50 Lnight in WHO-2009 for zero risk of cardiovascular disease. Participating receptors should be aware that indoor noise levels with the windows open, or partially open, may be higher than as recommended by WHO-1999 and may need to close their windows to reduce the potential for annoyance or sleep disruptions. Currently, the Application shows that the maximum Leq-1-h sound levels at participating receptors are predicted to be below the 52 dBA Leq-8-h regulatory limit that I am recommending.

Q. Do you have any recommendations for mitigation of noise and vibration after the Project is built?

A. Yes. In case 14-F-0490 the Siting Board adopted Certificate Condition 73, which contained a

series of steps and provisions for mitigation in case a compliance or violation test shows that the Facility exceeds any Certificate Conditions. Those conditions require presenting operational and physical minimization measures to the Board or the Commission, providing mitigation measures within reasonable time frames, retesting the mitigation measures implemented for compliance, as well as a restriction that prohibits the Facility to operate without the mitigation measures that are approved by the Siting Board or the Public Service Commission. These provisions are not included in the Certificate Conditions proposed by the Applicant for Baron Winds. Given their importance, those provisions as adopted for Cassadaga Wind, are reflected in DPS Staff's proposed Certificate Condition 71.

Q. Are there any differences between the Certificate Conditions Staff is recommending for noise and vibrations and the Certificate Conditions proposed by the Applicant as related to Postconstruction Compliance Evaluations?

A. Yes. In Certificate Condition 69, and as explained above, I am recommending adopting the Sound Testing Compliance Protocol presented by DPS in Exhibit__(MMC-7) and not the Protocol presented by the Applicant. Since the protocol presented by Staff already contains all the elements included in Cassadaga's Certificate Conditions 71(a), (b), and (c), I advise those provisions are not needed. For the same reasons, I am recommending the elimination of Applicant's Certificate Conditions 70(a), (b), (c), and (d).

Q. Are there any differences between the Certificate Conditions Staff is recommending and the Certificate Conditions proposed by the Applicant as related to regulatory noise limits to the Facility?

A. Based on my discussions in my testimony, I am recommending in Certificate Condition 72(b) that the Facility also be required to demonstrate compliance with the new WHO guidelines of 45-dBA Lden for any existing permanent or seasonal non-participating residence by post-construction

noise testing after the Facility is built. Alternatively, if the Siting Board decides not impose a Certificate Condition of 45 dBA Lden, 40 dBA L(night), or both, I recommend reducing the short-term regulatory noise limit from 45 dBA Leq (8-hour) to 42 dBA Leq (8-hour) for any existing participating receptors and from 55 (dBA) Leq (8-hour) to 52 (dBA) Leq (8-hour) for any existing non-participating receptors. This option is reflected in my alternate conditions included in Exhibit MMC-10 (Certificate Condition 72(a)). In addition, I am recommending that the noise descriptor for the 65-dB Leq low-frequency noise limit included in Certificate Condition 60(d) be clarified as 65 dB Leq-1-hour. This is consistent with the requirements for compliance filings for Cassadaga (Case 14-F-0490, Certificate Condition 70(d)(iii) and also with the noise descriptor specified in Certificate Condition 69(b)(3) proposed by the Applicant. I am also recommending clarifying that section D.2.(1) is

the relevant section of ANSI S12.9-200/Part 4 for the 65 dB-1-h limit for low frequency sounds proposed in Staff's Certificate Conditions. Also, in Staff's Certificate Condition 71, I am clarifying that "compliance" tests will refer to tests performed by the Applicant and "violation" tests will refer to those performed by DPS Staff. This to be consistent with the content and intent of ANSI Standard S12.9 Part 3. Finally, in Staff's Certificate Condition 74, I am clarifying that the Certificate Holder should keep both a schedule and a log of Noise Reduced Operations.

Q. Are the number and models of turbines presented in the Application the same currently considered for the project?

A. No. According to the information contained in the most recent supplement the number of turbines was reduced from 76 to 69. In addition, according to the sound data filed in the Application, the turbines as originally proposed were Vestas 117 3.3/3.45 MW and Vestas 136-3.45

MW. In the latest supplement, the turbines considered for the project are Nordex N117 3600 and GAMESA G114 2625.

Q. Had you identified the turbines that should have been eliminated from the original design?

A. Yes, turbines where the maximum NRO's of 7.5 dBA were applied were in my opinion the best candidates for elimination.

Q. To the best of your knowledge, as a result of the proposed modifications, were any of the turbines where the maximum NRO's of 7.5 dBA were applied proposed to be eliminated from design?

A. Turbines T1 and T74 were turned off in the computer model and in my opinion, they need to be eliminated from design. None of the other turbines with NRO's of 7.5 dBA were eliminated. Still, in my opinion, some of them should be eliminated.

Q. Are there any concerns?

A. Yes, the elimination of turbines where the maximum NRO's were applied and where the sound levels at impacted receptors are the highest is

preferred. In addition, the use of NRO's for computer noise modeling shows that the proposed layout does not conform with relevant thresholds and criteria unless NRO's are incorporated in the design. For those turbines additional NRO's required to comply with Certificate Conditions may be limited or unfeasible. In addition, NRO's also reduce the production of energy.

Q. Have you identified the turbines that would be recommended to be either eliminated or relocated?

A. Yes. Based on the modeling results under ISO 9613-2 and the geographical information system (GIS) information provided by the Applicant, Staff has generated drawings identifying non-participant noise sensitive receptors within the Project area differentiated by colors. The sound levels can be seen in the legends of these drawings Exhibit__(MMC-9). Turbines that are identified as candidates for elimination are: T1, T72 and T74 which needed to be turned off in computer noise modeling. T7 and/or T-18; T24,

T46, T47 and T-93; and T52 and/or T60.

Q. What is your recommendation?

A. My recommendation is that Noise Reduction Operations should not be used for computer noise modeling to demonstrate conformance with relevant criteria and that minimization measures should be provided during design for the most impacted receptors.

Q. Are there any mitigation measures that could be implemented if a non-conformance operational situation is found?

A. Yes. NRO's are the most practical mitigation measure that could be implemented after the Project is built provided they are sufficient to mitigate any actual exceedances.

Q. What are your final recommendations about the proposed Facility.

A. The design should keep the noise reduction operations (NROs) as a contingency option to mitigate any discrepancies between predicted and actual sound levels. Should sound levels at the non-participating or participating receptors

exceed relevant criteria or any Certificate Conditions imposed by the Siting Board after construction, then NRO's should be applied as necessary on relevant turbines to bring noise levels back into compliance.

Q. Does the proposed Facility avoid or minimize environmental impacts to the maximum possible extent?

A. No. I believe that the potential adverse environmental noise impacts from operation of the Facility have not been avoided or minimized to the maximum extent practicable. I also believe that additional minimization measures such as elimination or relocation of turbines needs to be explored.

Q. What is your recommendation to the Siting Board regarding granting a Certificate to the Applicant in light of the environmental noise impacts?

A. My recommendation as related to adverse environmental noise and vibration effects is that the Project should be approved subject to

the Certificate Conditions, the post-construction protocol, the regulatory limits that I am recommending for this project, and a redesign to include elimination of turbines without the use of NRO's so that the adverse environmental noise effects of the operation of the Facility are minimized or avoided to the maximum extent practicable. In my opinion the alternative presented in the Application Supplement does not avoid, offset or minimize the impacts caused by the Facility upon the local community for the duration that the Certificate is issued to the maximum extent practicable using verifiable measures. The Applicant should present updated computer noise modeling results considering the elimination of turbines that I am recommending and demonstrate that the adverse operational noise impacts have been minimized or avoided to the maximum extent practicable. The final computer model should determine whether additional turbines need to be relocated or eliminated in order to comply with

relevant thresholds and criteria as recommended in this testimony. In addition, the Applicant's proposed Certificate Conditions and Postconstruction Compliance Protocol are not sufficient to demonstrate that the Facility will in fact avoid, offset or minimize the impacts upon the most sensitive receptors to the maximum extent practicable using verifiable measures. Further, I recommend adoption of DPS Staff proposed Certificate Conditions on noise and protocol for demonstration of compliance after construction, if the Project is finally approved. The Applicant should present updated computer noise modeling results as a compliance filing to reflect any change introduced to the design such as different turbine model(s) or turbine locations, any changes on the list of receptors including any changes on participation status, to demonstrate that the adverse operational noise impacts have been minimized or avoided to the maximum extent practicable before a final design can be approved and construction

can begin.

Q. Does this conclude your testimony at this time?

A. Yes.