HIGH RIVER ENERGY CENTER

Case No. 17-F-0597

1001.19 Exhibit 19

Noise and Vibration

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Exhibit 19: Noise and Vibration

This Exhibit will track the requirements of proposed Stipulation 19, dated August 26, 2019, and therefore, the requirements of 16 NYCRR § 1001.19.

This Exhibit includes a detailed analysis of the potential sound impacts associated with the construction and operation of the Project. In order to assess the potential sound impacts, a Preconstruction Noise Impact Assessment (PNIA) for the construction and operation of the Facility was prepared by Ryan Callahan, INCE of Epsilon Associates, Inc. (Epsilon). The PNIA is provided as Appendix 19-1. Mr. Callahan has over 13 years of experience in the areas of community noise impacts, sound modeling, monitoring, and analyses. He is a full member of the Institute of Noise Control Engineering (INCE) in Noise Control Engineering. The modeling performed by Epsilon for the Facility is sufficiently conservative in predicting sound impacts and includes all proposed inverters and the substation operating simultaneously at their maximum capacities.

The Project has been designed so that no sensitive non-participating receptors, as defined below, will exceed 42 dBA Leq_{1hr}, and no non-participating receptors will exceed an annual nighttime level of 40 dBA ($Leq_{\text{night, outside}}$). The Project has been designed so that no sensitive participating receptors will exceed 52 dBA Leq_{1hr}, and no participating receptors will exceed an annual nighttime level of 50 dBA ($Leq_{\text{night, outside}}$). These proposed design goals, based upon the limits adopted by the Siting Board in Case 16-F-0062 in its order dated August 20th, 2019 (Eight Point Wind Energy Center, LLC) minimize and mitigate any adverse impacts associated with the sound produced by the construction and operation of the Project to the maximum extent practicable. Other Project design goals to minimize potential impacts are described further below.

19(a) Sensitive Sound Receptor Map

A map of the Noise Impact Study Area showing the location of sensitive sound receptors and participating receptors within one mile of the Facility components which generate noise (i.e., inverters, substation, etc.) is provided in Figure 19-1. Sensitive sound receptors include residences (participating, non-participating, full-time, and seasonal[1]), outdoor public facilities and areas, schools, hospitals, care centers, libraries, places of worship, cemeteries, public parks and

[1] Seasonal residences include cabins and hunting camps (identified by property tax codes) and any other seasonal residences with septic systems/running water.

public campgrounds, summer camps, and any historic resources listed or eligible for listing on the State or National Register of Historic Places, and Federal and New York State lands.

In total, 389 discrete receptors were analyzed for the project. These include 320 year-round residences, 87 seasonal residences, 39 public areas, and 22 unknown structures. All "unknown" structures were conservatively assumed to be residences. Of the 389 receptors, 12 were participating, and 377 were non-participating. Of the 320 year-round residences, 2 were participating and 318 were non-participating. Of the 8 seasonal residences, 2 were participating and 6 were non-participating. Of the 39 public areas, 6 were participating and 33 were non-participating. Of the 22 unknown structures, 2 were participating and 20 were non-participating. A desktop analysis using aerial imagery and tax classification codes from the New York Office of Real Property database were used to develop and classify sensitive sound receptors within one mile of proposed inverter and substation sites. Field verification was completed to verify the findings of the desktop analysis. If access for field verification was not possible, and aerial imagery could not provide an obvious classification of a structure (i.e. residential vs. non-residential), then the structure was classified as "unknown" and considered a sensitive sound receptor.

19(b) Evaluation of Ambient Pre-Construction Baseline Noise Conditions at Receptors

An evaluation of the ambient pre-construction baseline noise conditions was carried out for the Project. The details of the ambient study are described in the PNIA. A summary of information consistent with the Revised Scoping Statement (RSS) is found below.

1) A summer "leaf-on" measurement program was conducted at five locations for eight days in August 2018, and a winter "leaf-off" measurement program was conducted at five locations for nine days in April 2018. Both A-weighted and one-third octave band data were collected during day and night using a suitably calibrated sound level meter and octave band frequency analyzer (see Chapter 6 of the PNIA).

2) The ambient pre-construction baseline sound levels were filtered to exclude seasonal and intermittent noise by using a high-frequency natural sound (HFNS) filter and the L90 metric respectively (see Chapter 7.1 of the PNIA).

3) A high-frequency natural sound filter was applied to the measured one-third octave-band data from which a broadband sound level was calculated for both the summer and winter monitoring seasons. This technique removes all sound energy above the 1,250 Hertz frequency band. The methodology for the filtration process is as specified in ANSI/ASA

S12.100-2014 and the sound pressure levels presented in this report using this methodology are indicated as ANS-weighted levels (see Chapter 7.1 of the PNIA). The temporal accuracy section of the ANSI S12.9-1992/Part 2 document requires that the data collection must be long enough to achieve the desired confidence interval. The goal of the sound measurement program is to achieve a 95% confidence interval which would allow for a statement of 95% confidence that the true long-term average sound level falls within the given interval. The size of this confidence interval places the data set into one of three categories referred to as Class A, Class B, and Class C, listed here from most precise to least precise (see Chapter 8.6 of the PNIA).

4) Graphical timelines for the A-weighted L_{eq} and the L_{90} broadband noise levels for each pre-construction sound measurement location are found in Figures 7-3 to 7-20 of the PNIA.

5) Figures for the un-weighted L_{eq} and the L_{90} full-octave band noise levels (after exclusions, starting at the 16 Hz full octave band or 12.5 1/3 octave band) for each pre-construction measurement location are found in Figures 7-3 to 7-20 of the PNIA.

6) A description of how the pre-construction ambient surveys were conducted including specifications for sound instrumentation and weather meters, calibration, settings, positions that were tested, noise descriptors collected, range of sound frequencies evaluated, weather conditions, testing conditions to be excluded, schedules and time frames, testing methodologies and procedures, provisions for evaluation of existing tones and sounds with strong low frequency noise content are found in Chapters 6 and 7 of the PNIA.

7) Measurement locations, including GPS coordinates and AADT information of the nearest road, and a justification for location selection are found in Table 6-1 and Chapter 6.2 of the PNIA.

8) The seasonal noise was filtered from both measurements programs outlined in 19(1) by using the process specified in ANSI/ASA S12.100-2014 as stated in 19(2). The intermittent noise was be filtered by reporting the L90 as stated in 19(2). All data were collected for a minimum of 7 consecutive days.

9) Temporal accuracy of the L_{eq} and the L_{90} ambient data was calculated to a 95% confidence interval using the technique in Section 9 of ANSI S12.9-1992/Part 2 (R2013) (see Chapter 8.6 of the PNIA).

10) The sound instrumentation for ambient sound surveys complied with the following standards: ANSI S1.43-1997 (R March 16, 2007). Specifications for Integrating- Averaging Sound Level Meters; ANSI S1.11-2004 (R June 15, 2009) Specification for Octave-Band Analog and Digital Filters, and ANSI S1.40-2006 (R October 27, 2011) (Revision of ANSI 1.40-1984) Specifications and Verification Procedures for Sound Calibrators.

11) Data collected out of the range of operation of the sound instrumentation was excluded. Sound data collected at ground-level wind speeds exceeding five meters per second (11 miles-per-hour) at the sound microphone or portable weather station heights were also excluded. Pre-construction sound level data collected during periods of rain, thunderstorms and snowstorms were not used in the calculation of background sound levels. These exclusions are indicated on the graphs specified in Figures 7-1 to 7-18 of the PNIA.

19(c) Evaluation of Future Noise Levels during Construction

Construction of solar power projects requires the operation of heavy equipment and construction vehicles for various activities including construction of access roads, the installation of buried and above ground electrical interconnects, and the erection of solar panels. The noise generated by these activities will be associated with gasoline and diesel-powered engines, back-up warning signals, operating dump trucks, and possibly impact noise from jackhammers and/or rock drills, and equipment for horizontal directional drilling (HDD). The Applicant will coordinate with the public and provide notice by mail at least 14 days prior to commencement of Project construction activity.

Four areas within the Facility were analyzed for construction noise impacts. Sound levels were analyzed at the most potentially impacted and representative receptors using the ISO 9613-2 3-D sound propagation standard as implemented in the Cadna/A software package. Reference sound source information was obtained from either Epsilon measurements or the FHWA's Roadway Construction Noise Model (RCNM). Modeling and analysis procedures generally followed the guidelines and recommendations of the FHWA Highway Construction Noise Handbook. Most of the construction will occur at significant distances to sensitive receptors, and therefore noise from most phases of construction is not expected to result in impacts. As identified in Table 10-2 of the PNIA, there are a few instances where construction will be fairly close to residences (#197; #145) and coordination with these neighbors may be warranted. Details of the analysis and findings are presented in Chapter 10 of the PNIA.

19(d) Future Sound Levels from the Project

1) Future sound levels associated with the Project were predicted using the Cadna/A noise calculation software developed by DataKustik GmbH. This software implements the ISO 9613-2 international standard for sound propagation (Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation) for full octave bands from 31.5 Hertz (Hz) to 8000 Hz. The benefits of this software are a more refined set of computations due to the inclusion of topography, ground attenuation, multiple reflections, drop-off with distance, and atmospheric absorption. The Cadna/A software allows for octave band calculation of sound from multiple sources as well as computation of diffraction. No meteorological correction (Cmet) was used, and no CONCAWE meteorological correction was used. No corrections were necessary to apply to calculations used for future sound levels from the Project.

2) Full octave band calculations from 31.5 Hz to 8000 Hz were performed for the Facility using the ISO 9613-2 standard.

3) The manufacturer provided one-third octave band sound pressure level measurements of the inverter under ideal operational conditions, which were used to calculate inverter sound power levels from 12.5 to 20,000 Hz. Table 9-2 of the PNIA reports the broadband and octave band sound power level information for the inverter used for modeling.

4) Spectral ground absorption “G” was calculated using a G-factor of 0.5 which corresponds to “mixed ground” consisting of both hard and porous ground cover. This is consistent with the modeling guidelines of other renewable energy projects.

5) The predicted sound levels from ISO 9613-2 are reported for all sensitive receptors in tabular format in Appendix E of the PNIA. The results are presented both by receptor ID and sorted from highest to lowest sound levels. Sound levels at sensitive receptors and external property boundaries were generated by modeling

a grid to generate graphical isolines (noise contours) of A-weighted decibels for the Leq 1-hour, and Leq, night, outside. In addition, due to a small nearby existing solar facility, a cumulative Leq 1-hour modeling grid has been presented. These isolines are presented in Figure 9-2, 9-3 and 9-4 respectively in the PNIA. Full-size drawings were delivered to DPS and DOH in electronic media as well as in hardcopy format.

6) Participating and nonparticipating property boundaries are differentiated in the sound contour drawings. See Figures 9-2 through 9-4 in the PNIA. Each property is labeled with their unique tax code. Only parcels with a signed contract as of this filing are shown as participating.

7) Details of all the modeling assumptions are found in Chapter 9.3 of the PNIA. A temperature of 10 degrees Celsius and 70% relative humidity was used to calculate atmospheric absorption for the ISO 9613-2 model.

8) Chapter 9.3 of the PNIA has a detailed discussion of the accuracy of the propagation model, methodology, ground absorption, assumptions, and the correlation between measured and predicted sound levels from projects such as this. This section also includes a discussion of the Project Area topography.

9) The sound level modeling included any contributions from the collection substation and the power inverters which are part of this Project. Additional details on these sources are found in Chapter 9.2 of the PNIA.

10) One large body of water with moderate width (greater than 500 feet) was identified within the Project Area. This was the Mohawk River running West to East, which lies North of the Project Area. Therefore, this area was set to G=0 representing completely reflective surfaces.

19(e) Evaluation of Future Noise Levels during Operation of the Project

(1) Modeled A-weighted/dBA sound levels at all sensitive receptors.

Future noise levels during operation of the Project have been calculated using the methodology described above in 19(d) under the heading Sound Propagation Modeling – ISO 9613-2. Tables

E-1 and E-1.1 of Appendix E of the PNIA provides the predicted A-weighted (dBA) sound pressure levels at all sensitive receptors.

(2) Tonal Evaluation

ANSI S12.9 Part 3, Annex B, section B.1 (informative) presents a procedure for testing for the presence of a prominent discrete tone. According to the standard, a prominent discrete tone is identified as present if the time-average sound pressure level in the one-third octave band of interest exceed the arithmetic average of the time-average sound pressure level for the two adjacent one-third bands by any of the following constant level differences: 15 dB in low-frequency one-third-octave bands (from 25 up to 125 Hz); 8 dB in middle-frequency one-third-octave bands (from 160 up to 400 Hz); or, 5 dB in high-frequency one-third-octave bands (from 500 up to 10,000 Hz). A source of sound with a tone may be more annoying at the same A-weighted sound level than a source without a tone. Typically, the tone must be loud enough so that it is prominent, and thus annoying. The State of Illinois Pollution Control Board noise regulations recognize this fact by noting that their prominent discrete tone rule does not apply if the one-third octave band levels are 10 dB or more below the octave band limits in the IPCB regulations.

Sound pressure level calculations using the Cadna/A modeling software which incorporates the ISO 9613-2 standard is limited to octave band sound levels; therefore, a quantitative evaluation of one-third octave band sound levels using the modeling software was not possible. Instead, one-third octave band sound pressure levels due to the closest inverters were calculated at the nearest ten (10) potentially impacted and representative receptor locations (both non-participants and participants) using equations accounting for hemispherical radiation and atmospheric absorption.

The same method was used to assess whether a prominent discrete tone exists from the inverters. Calculations for the inverters used a spreadsheet approach since ISO 9613-2 does not accommodate one-third octave band data. For these calculations, the one-third octave band sound power data for the inverter was used. The results of these calculations are included in Table 11-4 of the PNIA and indicate that sound pressure levels due to the closest inverters at each of these locations are not predicted to result in any prominent discrete tones.

One-third octave band sound power levels for the substation transformer were not supplied by the vendor for the substation equipment; therefore, a quantitative evaluation of one-third octave band sound using the spreadsheet modeling approach was not possible. In general, substation transformers have the potential to create a prominent discrete tone at nearby receptors, specifically during the ONAN (fans off) condition. For this Project the substation is modeled to be less than 38 dBA at all non-participating sensitive receptors[2]. Therefore, prominent discrete tones from the substation are not a concern with this Project.

(3) Amplitude Modulation

Amplitude modulation is not an issue with solar projects and therefore an analysis was not included in the Application.

(4) An Evaluation of the Potential for Low Frequency and Infrasound

"Infrasound" is sound pressure fluctuations at frequencies below about 20 Hz. Sound below this frequency is only perceptible at relatively high magnitudes. "Low frequency sound" is in the nominal audible range of human hearing, that is, above 20 Hz, but below 200 Hz.

i) Low frequency sound levels for the full octave bands equal to or greater than 31.5 Hertz were evaluated at all sensitive receptors. The results are presented in Appendix E of the PNIA. No receptors with sound levels equal to or greater than 65 dB at 16, 31.5, or 63 Hz were found.

ii) Infrasound and low frequency sound levels down to 31.5 Hz were calculated for each receptor by Cadna/A and are presented in Appendix E for the PNIA. Solar projects do not produce significant levels of infrasound, and therefore no infrasound below 16 Hz was analyzed in the Application.

    Since the ISO 9613-2 standard does not include the 16 Hz frequency, results at the 16 Hz octave band for each receptor were extrapolated from the 31.5 Hz results. The extrapolation is the difference between the inverter's sound power data at 16 Hz and the sound power data at 31.5 Hz used for modeling as presented in Table 9-3 in the PNIA. The results are presented in Appendix E of the PNIA.

    Receptors were analyzed for infrasound at 16 Hz according to low frequency and infrasound criteria presented in ANSI 12.2-2008 and ANSI S12.9-2005/Part 4 seen in

[2] For perspective, a quiet library is around 35 dBA.

Table 11-1 of the PNIA. No receptors exceeded these criteria; thus, infrasound will conclusively not be an issue for this Project.

Details on the available sound data, methodology used for the calculations, and literature references are provided in Chapter 4.6.2 and Chapter 9.6 of the PNIA.

19(f) Sound Level at Receptors Table

(1) Daytime Ambient Noise Level

The daytime ambient noise level was calculated from summer and winter background sound level monitoring data. This is equal to the lower tenth percentile (L90) of sound levels measured during the daytime (7:00 AM – 10:00 PM) at each of the monitoring locations. These results are provided in Table 19-1 below (same as Table 8-1 in the PNIA). Sound levels in this section are presented both "as measured" and "ANS-weighted" (dBA) which removes all sound energy above the 1,250 Hertz frequency band. The ANS methodology is as specified in ANSI/ASA S12.100-2014 and is primarily aimed at removing high-frequency insect noise.

Table 19-1. Daytime Ambient L90 (dBA) Sound Pressure Level Summary

Location	Overall (dBA)		Winter (dBA)		Summer (dBA)	
	Measured	ANS	Measured	ANS	Measured	ANS
Location 1	46	45	44	44	49	45
Location 2	33	30	31	31	37	29
Location 3	28	26	27	27	39	26
Location 4	38	34	37	37	42	33
Location 5	38	35	36	36	44	34

(2) Summer Nighttime Ambient Noise Level

The summer nighttime ambient noise level was calculated from summer background sound level monitoring data. This was equal to the L_{90} of sound levels measured at night (10:00 PM – 7:00 AM) during the summer at each of the monitoring locations. These results are provided below in Table 19-2 (same as Table 8-2 in the PNIA).

Table 19-2. Nighttime Ambient L_{90} (dBA) Sound Pressure Level Summary

Location	Overall (dBA)		Winter (dBA)		Summer (dBA)	
	Measured	ANS	Measured	ANS	Measured	ANS
Location 1	41	40	40	40	53	39
Location 2	32	29	31	31	43	27
Location 3	29	26	27	27	46	25
Location 4	37	33	34	34	46	31
Location 5	37	34	36	36	50	33

(3) Leaf Off Nighttime Ambient Noise Level

The leaf-off (winter) nighttime ambient noise level was calculated from winter background sound level monitoring data. This was equal to the L_{90} of sound levels measured at night (10:00 PM – 7:00 AM) during the winter at each of the monitoring locations. These results are provided above in Table 19-2.

(4) Worst-Case Future Daytime Noise Level

The worst-case future noise level during the daytime period (7:00 AM – 10:00 PM) at all receptors was determined by logarithmically adding the daytime ambient sound level (L_{90}) (Table 19-1) as related to the use and soundscape of the location being evaluated, calculated from background sound level monitoring in the summer and winter, to the modeled upper 10th percentile sound level (L_{10}) of the Facility. The L_{10} statistical noise descriptor corresponds to estimates for one year of operation using site-specific sunrise/sunset data coupled with monthly sunshine probabilities for nearby Albany, New York. For a detailed description of the methodology used for this calculation see Chapter 9.3.3 of the PNIA.

These worst-case future noise levels during the daytime period are presented in Table G-2 in Appendix G of the PNIA. Worst-case future daytime noise levels range from 26 to 47 dBA for any non-participating receptor and from 37 to 47 dBA for any participating receptor. The highest L_{10} sound level at any sensitive non-participating receptor is 42 dBA. The highest L_{10} sound level at any sensitive participating receptor is 44 dBA.

(5) Worst-case Future Leaf on Nighttime Noise Levels

The worst-case future noise level during the summer leaf-on nighttime period at all receptors was determined by logarithmically adding the summer nighttime ambient sound level (L_{90}) (Table 19-2) as related to the use and soundscape of the location being evaluated, calculated from background sound level monitoring, to the modeled upper 10th percentile sound level (L_{10}) of the Facility. The L_{10} statistical noise descriptor corresponds to estimates for one year of operation using site-specific sunrise/sunset data coupled with monthly sunshine probabilities for nearby Albany, NY. These worst-case future noise levels during the daytime period are presented in Table G-2 in Appendix G of the PNIA. Worst-case future total summer nighttime noise levels range from 26 to 44 dBA for any non-participating receptor and from 37 to 44 dBA for any participating receptor. The highest L_{10} sound level at any sensitive non-participating receptor is 44 dBA. The highest L_{10} sound level at any sensitive participating receptor is 44 dBA.

(6) Worst-case Future Leaf Off Nighttime Noise Levels

The worst-case future noise level during the winter (leaf-off) nighttime period at all receptors was determined by logarithmically adding the winter nighttime ambient sound level (L_{90}) (Table 19-2) as related to the use and soundscape of the location being evaluated, calculated from background sound level monitoring, to the modeled upper 10th percentile sound level (L_{10}) of the Facility. The L_{10} statistical noise descriptor corresponds to estimates for one year of operation using site-specific sunrise/sunset data coupled with monthly sunshine probabilities for nearby Albany, New York. These worst-case future noise levels during the daytime period are presented in Table G-2 in Appendix G of the PNIA. Worst-case future winter nighttime noise levels range from 27 to 44 dBA for any non-participating receptor and from 37 to 44 dBA for any participating receptor. The highest L_{10} sound level at any sensitive non-participating receptor is 44 dBA. The highest L_{10} sound level at any sensitive participating receptor is 44 dBA.

(7) Daytime Ambient Average Noise Level

Measured daytime average ambient levels are presented in Table 19-3 below (same as Table 8-3 in the PNIA). The daytime ambient average noise level was calculated by logarithmically averaging sound pressure levels (L_{eq}) (after exclusions) from the background sound level measurements over the daytime period at each monitoring location. These calculations include both summer and winter data combined.

Table 19-3. Daytime Ambient L_{eq} (dBA) Sound Pressure Level Summary

Location	Overall (dBA)	
	Measured	ANS
Location 1	57	55
Location 2	54	52
Location 3	54	49
Location 4	56	53
Location 5	55	50

(8) Typical Facility Noise Levels

Typical Facility noise levels for each sensitive receptor were calculated as the median sound pressure level emitted by the Facility at each evaluated receptor (L_{50}). The median sound pressure level was calculated by determining the frequency of site-specific meteorological conditions during periods when the facility has the potential to be operating. The L_{50} statistical noise descriptor corresponds to estimates for one year of operation using site-specific sunrise/sunset data coupled with monthly sunshine probabilities for nearby Albany, New York. For a detailed description of the methodology used for this calculation see Chapter 9.3.3 of the PNIA. The typical Facility sound levels are presented in Tables G-1 in Appendix G of the PNIA.

(9) Typical Facility Daytime Noise Levels

The typical Facility daytime (7:00 AM – 10:00 PM) noise level at all receptors was determined by logarithmically adding the daytime equivalent average sound level (L_{eq}) calculated from background sound level monitoring (Table 19-3) as related to the use and soundscape of the location being evaluated, to the modeled median Facility sound pressure level (L_{50}). The L_{50} statistical noise descriptor corresponds to estimates for one year of operation. These typical Project daytime noise levels are presented in Table G-2 in Appendix G of the PNIA. Typical Project daytime noise levels range from 49 to 55 dBA for any non-participating receptor and from 49 to 55 dBA for any participating receptor. The 55 dBA sound levels are due to the existing sound sources in the project area and are not due to the project.

19(g) Applicable Noise Standards, Local Requirements, and Noise Design Goals for the Facility

Noise standards applicable to the Project, as well as noise guidelines that are required by or recommended by various agencies, are described below. More information on these standards and design goals is included in Chapter 4 of the PNIA. The input parameters, assumptions and standards that were used for purposes of predicting sound pressure levels from the Facility's substation and inverters are discussed in detail in Section (d) above. The compliance with these standards is discussed below and in Table 19-4 in Exhibit 19(h).

A balance must be struck between avoiding or minimizing potential impacts to the maximum extent practicable from Project generated sound while not imposing regulatory standards which are so stringent that they do not afford additional benefits but instead are prohibitive to Project viability. Regulatory limits for other power generation and mechanical processes never seek inaudibility but rather to limit noise from a source to a reasonably acceptable level. Seven preliminary design goals are herein proposed for the Project and are described in more detail below.

Noise design goals were developed in order to balance reasonable development and minimize annoyance to the community. These include an annual nighttime level of 40 dBA ($L_{eq,\ night,\ outside}$) at a non-participating residence (Goal #1), and also a 50 dBA ($L_{eq,\ night,\ outside}$) at a participating residence (Goal #2). This is consistent with the limits adopted by the Siting Board in its certification of the Eight Point Wind Energy Center (Case 16-F-0062). Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated August 20, 2019 ..

A maximum short term broadband (1-hour L_{eq}) sound level (day or night) of 42 dBA is a design goal for all non-participating residences (Goal #3), and 52 dBA is the design goal for this metric at participating residences (Goal #4). These design goals are also consistent with condition #73(a) of the Eight Point Wind order.

The WHO 1999 notes daytime and evening outdoor living area sound levels at a residence should not exceed an L_{eq} of 55 dBA to prevent serious annoyance and an L_{eq} of 50 dBA to prevent moderate annoyance from a steady, continuous noise. Since a property line is not a "living area", or even an area where people routinely spend extended time, limiting 1-hour L_{eq} sound levels to 55 dBA or less at non-participating property lines is a reasonable design goal (Goal #5). With a limit of 55 dBA at the boundary line, sound levels inside the boundary line will be less than 55 dBA.

Another design goal for non-participating residences is to prohibit an “audible prominent tone” in accordance with ANSI S12.9 Part 3/Annex B Section B.1 or impose a 5 dBA penalty to the broadband limit if a pure tone occurs (Goal #6).

Solar facilities produce very low levels of infrasound, which are well below human thresholds of audibility. However, infrasound and low frequency energy can result in airborne vibration within homes if the levels are high enough. American National Standard ANSI S12.9-2005/Part 4 identifies that low frequency sound annoyance is minimal when the 16, 31.5 and 63 Hz octave band sound pressure levels are each 65 dB or less, and therefore sound pressure levels 65 dB or less in those three octave bands is a design goal at non-participating residences (Goal #7).

19(h) Tabular Outline of Noise Standards for the Facility

Design goals for the Facility are provided below in Table 19-4. The Town of Florida does not have any noise regulations applicable to this facility. Based on the detailed analyses presented in this report, the future Project sound levels will meet all design goals. A detailed discussion is found in Chapter 12 of the PNIA.

Table 19-4. Summary of Compliance with Sound Standards and Design Goals - High River Energy Center

#	Design Goal. (Not to exceed)	Assessment Location	Noise descriptor	Period of Time	Participant Status	Meet?
1	40 dBA	At residence, Outdoor	Lnight-outside (Leq)	Annual; nighttime	Non-participant	Yes
2	50 dBA	At residence, Outdoor	Lnight-outside (Leq)	Annual; nighttime	Participant	Yes
3	42 dBA	At residence, Outdoor	Leq	1-hour; daytime or nighttime	Non-participant	Yes
4	52 dBA	At residence, Outdoor	Leq	1-hour; daytime or nighttime	Participant	Yes
5	55 dBA	Property line except for portions delineated as wetlands	Leq	1-hour; daytime or nighttime	Non-Participant	Yes
6	No audible prominent tones or 5 dBA penalty if they occur.	At residence, Outdoor	Leq	1-hour; daytime and nighttime	Non-participant	Yes
7	65 dB at 16, 31.5, and 63 Hz full-octave bands.	At residence, Outdoor	Leq	1-hour; daytime and nighttime	Non-participant	Yes

19(i) Noise Abatement Measures for Construction Activities

Noise due to construction is an unavoidable outcome of construction. The Applicant will communicate with the public to notify the beginning of unlimited and continuous construction of the Facility. Most of the construction will occur at significant distances to sensitive receptors, and therefore noise from most phases of construction is not expected to result in impacts. However, the Complaint Resolution Plan provided as Appendix 12-3 of this Application contains the procedures to be followed in the event of a noise complaint during construction. Nonetheless construction noise will be minimized through the use of best management practices (BMP) such as those listed below.

- Blasting is not anticipated at this site. However, if necessary, blasting will be limited to daytime hours and conducted in accordance with the Project's Preliminary Blasting Plan included as Appendix 21-2.
- Post installation and horizontal direction drilling (HDD) will be limited to daytime hours. See the preliminary geotechnical report for more detail.
- Utilizing construction equipment fitted with exhaust systems and mufflers that have the lowest associated noise whenever those features are available.
- Maintaining equipment and surface irregularities on construction sites to prevent unnecessary noise.
- Configuring, to the extent feasible, the construction in a manner that keeps loud equipment and activities as far as possible from noise-sensitive locations.
- Using back-up alarms with a minimum increment above the background noise level to satisfy the performance requirements of the current revisions of Standard Automotive Engineering (SAE) J994 and OSHA requirements.
- Develop a staging plan that establishes equipment and material staging areas away from sensitive receptors when feasible.

Contractors shall use approved haul routes to minimize noise at residential and other sensitive noise receptor sites.

(1) Complaint Resolution Plan

Complaints due to construction or operation of the Project have the potential to occur. If complaints do arise, the Complaint Resolution Plan provides information on how and when the public may file a complaint, as well as an identification of any procedures or protocols that may be unique to each phase of the Project or complaint type.

The following four complaint filing methods are described in greater detail in Appendix 12-3:

1. Call the Applicant at **(800) 214-7929**, or call the Construction Manager during construction, or the Site Manager once the Project is operational, at the numbers listed in Table 1 of Appendix 12-3;
2. Meet with local High River Energy Center employees in person at the temporary construction office;
3. Submit a complaint in writing by mailing a detailed complaint to the following address:
   High River Energy Center, LLC,
   700 Universe Blvd., FEW/JB
   Juno Beach, FL 33408; or
4. Submit a complaint in writing by emailing a detailed complaint to the Construction Manager during construction or the Site Manager once the Project is operational.

The Complaint Resolution Plan is provided as Appendix 12-3 and includes a Sound Complaint Log Sheet to be filled out and retained for each complaint received during both construction and operation of the Project. The Plan includes a procedure for review and transmittal of Sound Complaint Log Sheets to the compiled complaint log made available to the DPS Staff. Should any complaints qualify for complaint-based sound monitoring, the results of the testing will be provided in a report to the complainant, to the Town Clerk upon request, and the DPS.

19(j) Noise Abatement Measures for Facility Design and Operation

In order for the High River project to meet all noise design goals, two sound barrier walls are required. One L-shaped barrier is proposed around inverter #10, and a three-sided barrier is proposed around inverter #16. Each sound barrier was assumed to be 8 feet tall, with a minimum STC rating of 30. More details are provided in Section 9.4.1 of the PNIA. Interior sound levels at a noise sensitive receptor may be reduced through use of better doors, windows, and/or insulation.

19(k) Community Noise Impacts

(1) Potential for Hearing Damage

The Project's potential to result in hearing damage was evaluated against three guidelines established by the OSHA, USEPA, and WHO. Comparison of sound propagation modeling to these guidelines shows that construction and operation of the Project will not result in potential for hearing damage. Each of the standards and the Facility's compliance with them is further described below.

OSHA protects against the effects of noise exposure in the workplace. Permissible noise exposure levels for an 8-hour day are 90 dBA. At sound levels above 85 dBA over an 8-hour workday, employers shall provide hearing protection to employees. Sound pressure levels as generated by Project construction and operation at sensitive sound receptors will be under this threshold, so the Project will be in compliance with OSHA standards. Therefore, based on the OSHA standard, the Project will not result in potential for hearing damage.

The USEPA established a noise guideline for protection against hearing loss in the general population (USEPA, 1974). The guideline identifies a sound level of 70 dBA over a 24-hour period as protective against hearing loss from intermittent sources of environmental noise. The highest predicted sound level at a non-participating residence is 42 dBA.

According to the WHO 1999 Guidelines, the threshold for hearing impairment is 110 dBA (Lmax, fast) or 120/140 dBA (peak at the ear) for children/adults. The only construction noise source for this Project capable of exceeding the WHO hearing impairment threshold is blasting, but no blasting is anticipated for this Project. All other construction activities will produce noise below the WHO hearing impairment threshold.

In addition, if any blasting is required, the contractor responsible for blasting will have a Health & Safety Plan approved by the Applicant. This plan will include the appropriate worker hearing protection and procedures to prevent hearing loss from impulse noise.

(2) Potential for Speech Interference

The Facility's potential to result in indoor and outdoor speech interference was assessed using the framework provided in the WHO (1999) document Guidelines for Community Noise and in the USEPA (1974) document Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.

The 1974 USEPA document states that for an outdoor level of 55 dBA (L_{dn}) there is 100% sentence intelligibility indoors, and 99% sentence intelligibility at 1 meter outdoors. These are the maximum sound levels below which there are no effects on public health and welfare due to interference with speech or other activity. This includes a 5 dBA margin of safety. An outdoor L_{dn} is equivalent to a 24-hour sound level of 49 dBA. Because all non-participating sensitive sound receptors were modeled to have the highest operational sound level less than or equal to 45 dBA, the Facility will not result in interference with indoor or outdoor speech, as defined by USEPA guidelines.

The WHO recommends and indoor sound level of 35 dBA (L_{eq}) to protect speech intelligibility. This is equivalent to approximately 50 dBA L_{eq} outdoors based on reduction from outside to inside by approximately 15 dBA with windows open, and 25 dBA with windows closed (USEPA, 1974). Because all non-participating sensitive sound receptors were modeled to have the highest operational sound level of less than or equal to 42 dBA, the Project will not result in interference with indoor or outdoor speech, as defined by USEPA guidelines.

(3) Potential for Annoyance/Complaints

As part of the Project, noise design goals were developed based on a literature review in order to balance reasonable development and minimize annoyance to the community. An extensive search was made of noise-related publications from professional organizations such as the Institute of Noise Control Engineering (INCE) and the Acoustical Society of America (ASA) along with their associated annual conference proceedings. Very few papers have been published on sound from solar energy facilities, and none were located that analyzed potential annoyance from solar energy facilities. This is not surprising given that sound from photo-voltaic solar systems is a very minor source of sound energy. Therefore, annoyance due to sound from solar energy is expected to be negligible to non-existent.

The number of non-participating receptors modeled at worst-case sound levels above 40 dBA was seven (five receptors at 41 dBA and two at 42 dBA). All other non-participating receptors are expected to have worst-case sound levels of 40 dBA or less. These are almost exclusively daytime sound levels. Except for a few early morning hours in the summer, the sun will not be shining at night, and thus nighttime sound levels from the inverters will be zero. More details on the short-term modeling results are found in Table 9-8 in the PNIA.

(4) Potential for Structural Damage

At this time, blasting is not planned as part of construction for the Project. If blasting becomes necessary, a Preliminary Blasting Plan is provided as Appendix 21-2 and the Preliminary

Geotechnical Report is provided as Appendix 21-1. Summaries of these reports are in Exhibit 12 and Exhibit 21 of the Application. It is anticipated that post installation will be needed to construct the Project. Potential for any cracks or structural damage due to impact activities during construction is analyzed in Exhibits 12 and 21.

(5) Potential for Air-Borne or Ground-Borne Transmitted Vibrations

Solar facilities do not produce significant levels of ground-borne vibration, and therefore no analysis of ground-borne vibration was conducted.

The potential for air-borne induced vibrations from the operation of the Project to generate annoyance, cause vibrations, rumbles or rattles in windows, walls or floors of sensitive receptor buildings was analyzed by applying the outdoor criteria established in annex D of ANSI standard S12.9 - 2005/Part 4 and applicable portions of ANSI 12.2 (2008). Table 11-1 in the PNIA shows the low frequency ANSI 12.2-2008 and ANSI S12.9-2005/Part 4 criteria.

Modeling results at the 31.5 Hz and 63 Hz low frequency octave bands have been calculated using Cadna/A acoustic model. Results at the 16 Hz octave band, for each receptor, were extrapolated from the 31.5 Hz results. The extrapolation is the difference between the inverter's sound power data at 16 Hz and the 31.5 Hz sound power data used for computer modeling. Complete octave band sound pressure level results at each receptor for the Project is presented in Appendix E of the PNIA.

No receptors were found to experience sound levels equal to or greater than 65 dB at 16, 31.5, or 63 Hz.

19(l) Post-Construction Noise Evaluation Studies

The Applicant proposes post-construction sound monitoring to take place in the first year of operations. Testing is proposed at up to four locations, representing the noise sensitive receptors with the highest predicted sound level based on acoustic modeling and/or complaints. A Sound Monitoring and Compliance protocol with more information is attached as Appendix 19-2.

19(m) Post-Construction Operational Controls and Mitigation Measures to Address Complaints

The Applicant takes seriously any complaints that it receives from members of the public. The Complaint Resolution Plan for the Facility, which is included as Appendix 12-3, includes a complaint response protocol specific to noise during Project construction and operation. In addition, the Applicant will provide a noise and vibration complaint resolution plan during construction of the Project. Should a resident feel the Project is creating noise levels above those specified in the Project's Certificate Conditions, the resident may issue a complaint. Complaints will be able to be made in person, via phone, or by email. If necessary, the Applicant will contact the individual within 72 hours of the complaint. The Applicant will implement a comprehensive response for all registered, reasonable complaints, which will include community engagement, gathering information, response to the complaint, a follow up after the response has been issued, and further action if the complainant believes that the issue continues to exist. Should noise levels exceed those established in the Facility's Certificate, post-construction operational controls could be utilized to reduce noise, including noise barriers.

19(n) Software Input Parameters, Assumptions, and Associated Data for Computer Noise Modeling

Specific modeling parameters are included as Appendix D of the PNIA prepared by Epsilon. GIS files containing modeled topography, modeled inverter and substation locations, sensitive sound receptors, and all external boundary lines identified by Parcel ID number are being provided to DPS under separate cover in digital format. The digital Cadna/A input files will not be provided.

References

A complete list of citations and references is found throughout the footnotes in the PNIA.