Mohawk Solar

Case No. 17-F-0182

1001.19 Exhibit 19

Noise and Vibration

EXHIBIT 19 NOISE AND VIBRATION

Compared with all other types of power generation facilities, the potential for any kind of community sound impact from a photovoltaic solar energy project is almost non-existent. The only potential source of sound is confined to the step-up transformer in the new substation, electrical inverters within the various solar panel fields and some short-lived activities during construction. Additionally, solar facilities have the unique characteristic of only operating during daylight hours, when sound is much less likely to be an issue in the first place. There are no vibration issues associated with the operation of such a facility.

(a) Substation Sound Emissions

The power generated by the Facility[1] will be collected and routed to a step-up transformer in the collection substation. The potential sound impact from any substation is essentially a matter of how prominent and audible the tonal sound emissions are from the transformer(s) to the nearest residences. General broadband (A-weighted) sound is of no real concern. Tones at harmonics of 60 Hz are generated by all transformers and are always noticeable close to the unit as a hum or buzz; however, the prominence of these tonal peaks diminishes quickly with distance and disappears into the background. More specifically, it is generally the case that the principal tones, usually at 120, 360 and/or 480 Hz, become largely imperceptible at distances ranging from 150 to 750 feet, depending on the size and capacity of the transformer(s). Consequently, if a proposed substation is more than 750 feet from any adjacent residence it can be reasonably concluded that no significant adverse noise impact will occur. A Sound Emissions Assessment (SEA) was conducted by Hessler Associates, Inc. (Hessler, 2019) to identify and quantitatively evaluate any potential community sound associated with the Facility (Appendix 19-A). As indicated in the SEA, the Facility's proposed collection substation is located much further than 750 feet from any residences; consequently, no adverse tonal sound impact is anticipated at any potential sensitive receptor.

(1) Sensitive Sound Receptor Map

A map of the Sound Emissions Study Area showing the location of sensitive sound receptors (residences, schools, hospitals, hiking trails, etc.). within 1500 feet of the Facility Site is provided in Figure 19-1. In addition, Figure 2.1.1.1 of the SEA (Appendix 19-A) shows the location of the collection substation in relation to the nearest residence, which is approximately 1,850 feet away.

[1] As defined throughout this Application, the Facility refers to all components of the proposed project, including PV panels and support structures, inverters, access roads, buried and above ground collection lines, a generation tie line (or "gen-tie"), a substation, a switching station, fences, and staging areas.

(2) Ambient Pre-Construction Baseline Noise Conditions

Ambient Sound Monitoring Locations

On behalf of the Applicant, Hessler completed winter (leaf-off) and summer (leaf-on) background sound level monitoring at three representative locations distributed throughout the Facility Site. Monitoring locations were selected to evaluate existing environmental sound levels at the nearest residence to the substation and two other general locations representative of the overall site vicinity.

Each of the three locations are described below. See Figure 2.1.1 of the SEA for locations of the monitoring sites. Photographs of the setup monitors are also included in the SEA.

- **M-1 –** This monitor represents the nearest residence to the collection substation. A frequency analyzer, along with a back-up unit, were set up as continuous sound monitors at a position on the edge of the existing transmission line right-of-way 300 feet west of the house (Figures 2.1.1.1 and 2.1.1.2 of the SEA)
- **M-2 –** This monitor was located in an open field off Nestle Road in the northeastern part of the Facility Site (Figures 2.1.2.1 and 2.1.2.2 of the SEA).
- **M-3 –** This monitor was set up in the southern part of the Facility Site at a location in a field approximately 370 feet north of Dygert Road near its intersection with Bowerman Road (Figures 2.1.3.1 and 2.1.3.2 of the SEA).

Ambient Sound Level Monitoring

Background sound level monitoring was performed at these three locations in the winter of 2018 (January 4 to January 30) and in the summer of 2018 (June 28 to July 7). Sound level data were collected with Norsonic N-140, American National Standards Institute (ANSI) S1.4-1983 (R2006) Type 1 precision, 1/3 octave band frequency analyzers. Weather treated 7-inch diameter windscreens were used to minimize self-generated distortion from wind on the primary instruments. The microphones were fixed to temporary posts at a high of 1.2 meters (approximately 4 feet) above local grade. Each instrument was field calibrated with a Brüel Kjær Type 4230, ANSI S1.40-1984(R1990) Type 1 calibrator at the beginning and end of the survey and all primary meters exhibited a drift within a +/- 0.2 decibel (dB) range.

A variety of statistical sound levels (minimum, maximum, average, etc.) were measured in 10 minute increments over each survey period. However, because the Facility and associated substation will only be active during the day when the sun is out, the parameter of primary relevance and importance to this survey is the average daytime L90 percentile level, which is the sound level exceeded 90% of the time over each measurement period.

The 1/3 octave band spectra were also recorded at each location to document any pre-existing tonal sounds in accordance with Annex K of ISO 1996:2:2017(E).

Weather conditions were monitored during the survey period. During the winter survey period, weather conditions were generally favorable in the sense there was no precipitation and the wind speeds were generally moderate, except on the first day when gusty conditions were present. There was also a lack of precipitation during the summer survey, but there were several periods of moderately high winds on June 30, July 2, and July 3. All data collected during windy periods was discarded from the final averages.

Baseline Sound Monitoring Results

Baseline sound data were analyzed and are discussed in the SEA. A summary of the ambient sound monitoring results during the winter and summer is provided below.

- Winter Survey – Figure 3.1.1 of the SEA shows the L90 winter survey results at each monitoring location. The results show sound levels typically in the 20 to 35 dBA range. Slightly higher sound levels of about 40 dBA, occur during windy conditions due to wind-induced natural sounds. The overall average A-weighted sound level during daylight hours (approximately 7:00 a.m. to 5:00 p.m.) omitting all data from windy periods was approximately 28 dBA, which per the NYSDEC Program Policy "Assessing and Mitigating Noise Impacts" (NYSDEC, 2001) is considered very quiet. The average daytime L90 1/3 octave band spectrum, specifically at monitoring location M-1 indicates that there are no pre-existing tonal sounds in the vicinity of the substation; i.e. there are clearly no prominent 1/3 bands protruding above the surrounding spectrum that would meet the ISO 1996:2 Annex K definition of a prominent discrete tone.
- Summer Survey – Figure 3.2.1 of the SEA shows the L90 summer survey results at each monitoring location. The results exhibit a clearer diurnal pattern than was found in the winter survey characterized by an abrupt increase in sound around 4:45 AM every morning off the nighttime lows of about 22 dBA. This increase occurs simultaneously at all three monitoring positions. The as-measured overall average A-weighted sound level excluding high wind periods during daylight hours (approximately 5:30 a.m. to 8:30 p.m.) was 32 dBA, which per the NYSDEC Program Policy "Assessing and Mitigating Noise Impacts" (NYSDEC, 2001) is considered very quiet. This sound level is marginally higher than winter results due to a slight increase in high frequency sound associated with minor summertime insect activity. The average daytime L90 1/3 octave band spectrum, specifically at monitoring location M-1 indicates that there are no pre-existing tonal sounds in the vicinity of the substation, with the possible exception of extreme high frequency insect sounds around 16,000 Hertz (Hz). Omitting these high

frequency bands per ANSI S12.100 results in a recalculated average background level of 25 dBA. Generally speaking, both surveys, with average daytime sound levels in the mid-20's dBA, indicate that there is no significant background masking sound in the project area.

(3) Modeling of Operational Sound Levels

The Edison Electric Institute (EEI) published the *Electric Power Plan Environmental Noise Guide* in 1984. The study measured numerous transformers over a wide range of sizes and manufacturers to develop a formulaic relationship between MegaVolt Ampere (MVA) rating and sound power. The sound power level for the main step-up transformer in the collection substation has been conservatively estimated in octave bands in Table T-2096-011419-A of the SEA based on the unit's maximum expected MVA rating of 110 using empirically derived algorithms from the EEI study. The precise transformer model, rating, and manufacturer have not yet been finalized, so 110 MVA is considered the best estimate at this time.

The algorithm predicts a near field sound pressure level of 80 dBA (likely a conservative estimate by about 5 dBA) resulting in a sound power level of 99 dBA re 1 pW. Based on this sound power level, the sound emissions from the substation were calculated (in Table T-2096-021419-A) at the nearest potentially sensitive residence in accordance with International Organization for Standardization (ISO) 9613-2 *Acoustics – Attenuation of Sound during Propagation Outdoors* (1996).

A mid-range, somewhat conservative ground absorption coefficient of 0.5 was used to represent the Facility Site vicinity, which generally consists of open fields and intermittent wooded areas. There are no major undulations in the topography near the collection substation, so a flat plane is assumed along ISO "standard day" conditions (10 degrees Celsius and 70% relative humidity).

The nearest residence is approximately 1,850 feet from the proposed collection substation (Figure 4.3.1 of the SEA). The overall A-weighted sound level from the proposed substation transformer at this point is calculated at an extremely quiet and probably inaudible 32 dBA. This predicted sound level is well below any existing disturbance threshold for daytime exposure, such as the latest WHO (2018) environmental noise guideline levels, which range from 45 to 54 dBA during the day depending on the type of source. As a result, no adverse sound impacts are expected from the collection substation at the closest residence, nor, by extension, at any other, more distant receptor location.

An A-weighted sound level contour map out to 30 dBA with 1 dB resolution is provided in Plot 1 of the SEA.

(4) Impact Assessment

As described above, the overall A-weighted daytime sound level predicted at the nearest residence (Design Point [DP] – 1) ranges from 25 to 28 dBA depending on season. However, because transformer sounds are characterized by hums and tones, its frequency content is generally of more importance than its overall magnitude. The Modified Composite Noise Rating (MCNR) is an assessment approach that uses the frequency spectrum of the source and the background to evaluate potentially intrusive sound and predict community reaction. MCNR classifications rank from A to I with a MCNR ranking of A having the lowest impact, or a significance of "no reaction", while a rank of I has a high impact, or significance of "vigorous action." These ranks are presented in detail in Table 4.3.4 of the SEA.

MCNR classification letters are applied to a plot of the octave band frequency spectrum of the predicted project-only sound level against curves that generally map perceptibility of the sound as a function of frequency (see Figure 4.3.2 of the SEA). Starting from the baseline rating classification, a series of corrections and adjustments are made to estimate the final classification, which in turn, gives an indication of the potential community reaction. These corrections include background masking sound, the temporal nature of the new sound source, the sound source character, and the general attitude of observers. The corrections and final ratings for the nearest residence are listed in Table 19-1 below and are described in additional detail in Section 4.3 of the SEA.

Table 19-1. Summary of CNR Correction Factors and Final Ratings

Correction	DP-1 Winter	DP-1 Summer
Initial Rating Based on Model Prediction	a	a
Background Correction	+2	+2
Temporal/Seasonal Correction	-1	-1
Character Correction	0	0
Exposure and Attitude	0	0
Net Correction	+1	+1
Final Rating	**B**	**B**

The rating of B indicates that "no reaction" is anticipated at the nearest potentially sensitive receptors. Because the sound emissions from the collection substation are expected to be negligible at the nearest home, approximately 1,850 feet from the substation, the potential sound impact at more distant receptors will clearly be lower, making it unnecessary to tabulate or specifically quantify those levels.

(b) Inverter Sound Emissions

Apart from the substation transformer, the only other sound sources of any possible significance are the electrical inverters used to convert locally generated DC current into AC power that is then routed to the substation through underground collector cables. Typically, these electrical cabinets are situated within and near the center of each solar field, or independent group of solar panels, so they are usually a considerable distance from the perimeter fence and potential neighbors beyond. For this Facility, the DC to AC conversion will be implemented by many small string inverters, which are essentially small electrical boxes attached to each panel rack. These small-scale inverters then feed AC power to medium/low voltage transformers, called secondary skid units (SSUs) that in turn relay the power to the collection substation.

The sound power level produced by the string inverters is not precisely known but is given by the manufacturer as less than 65 dBA at a distance of 1 meter, which is similar in magnitude to a normal conversation. Consequently, these components may be neglected as significant sound sources with the potential to affect off site residents hundreds of feet, or more, away.

The SSU units are also relatively small and are estimated by the manufacturer to generate a near field sound level of only 53 dBA, which may also be considered a negligible sound source. Nevertheless, because these units appear on the current site plan and because the octave band sound power level can be conservatively estimated from the transformer's 2 MVA rating, their sound emissions have been calculated and are provided in Table T-2096-021419-A of the SEA and site-wide contours mapped out to 30 dBA are shown in Plot 1 of the SEA. These contours were generated using Cadna/A® software assuming a mid-range ground absorption coefficient of 0.5. The SSUs are shown as red dots in the plot. The 30 dBA sound level contour is so close to each SSU that the contour lines can only be seen in the enlarged inset. In no case does the 30 dBA contour reach any participating or non-participating home in the area. At the nearest non-participating residence (i.e., residence of a property that is not within the Facility Site) to any SSU (DP-5 in Plot 1), at a distance of approximately 360 feet from a group of several SSU's, a negligible sound level of 26 dBA is predicted. At the nearest participating residence (DP-3; i.e., residences on properties that are within the Facility Site), which is located 240 feet from a single SSU, an equally low sound level of 26 dBA is also predicted. Equivalent or lower levels would occur at all other residences. Consequently, no adverse community sound impact, regardless of participation status, is anticipated from the Facility's electrical inverters.

(c) Construction Noise

The duration of the construction phase for the Mohawk Solar facility is anticipated to require approximately 12 months, although the activities that generate any significant sound are few and will not extend the full phase of construction. The construction of a solar plant involves less intrusive measures, such as the installation of mounting piers for the panel racks, some grading and earthwork to construct access roads, the erection of the operations and maintenance building and collection substation, and collection line trenching.

There are two basic methods of erecting the piers: pier driving or rotating screw bases. If the piers are driven in, it is essentially a small-scale pier driving operation that produces a repetitive, metallic pounding sounds, which will be clearly audible for some distance and could cause some unavoidable disturbance. However, this activity is temporary and will be limited to the duration of construction. If the piers are screwed in there may be some local sound from the driving apparatus; however, any community impact is likely to be minimal.

Table 19-3 shows the modeled A-weighted sound power levels for the louder pieces of construction equipment expected to be used during construction of the Facility, along with the phase of construction in which the equipment will be used. These types of sounds from trenching and road building will also be brief and will progress from place to place avoiding prolonged exposure at any specific location.

Table 19-3. Sound Levels for Sound Sources Included in Construction Modeling[1]

Equipment Description	Typical Sound Level at 50 feet, dBA	Estimated Maximum Total Level at 50 feet per Phase, dBA[2]
Blasting		
n/a	n/a	n/a
Earthmoving Road Construction and Electrical Line Trenching		
Dozer	85	85
Front End Loader	80	
Grader	85	
Backhoe	80	
Support Pier Installation		
Vermeer PD10 Pile Driver[3]	84	84 (Impulse Driven Piers)
Drill Rig Truck	84	84 (Broadband for Screwed Piers)
Truck Traffic Material Delivery		
Flatbed Truck	84	84
Erection Panel Installation		
Mobile Crane	85	85

[1] Source: USDOT, 2006.
[2] Not all vehicles are likely to be in simultaneous operation. Maximum level represents the highest level realistically likely at any given time.
[3] Based on manufacturer's information.

As indicated in the table, no blasting is anticipated for the Facility. In addition, there is a limited need for concrete pouring within the solar fields, since the medium voltage transformers will likely be set on pre-cast concrete pads.

The majority of the concrete pouring would be for the transformer base in the collection substation. A concrete pump truck typically generates a sound level of about 82 dBA at 50 feet, or the boundary of the substation. At the nearest house (DP-1), 1,850 feet away, this sound level would decrease to around 45 dBA and occur only intermittently during the day; most likely only for a day or two.

In summation, the sound emissions during the construction of the proposed Facility are expected to be low in magnitude and short in duration. However, as stated above, some unavoidable disturbance is possible, such as when the mounting piers are driven in. Other sounds from trenching and road building will also be brief and will progress from place to place avoiding prolonged exposure at any specific location.

REFERENCES

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