South Ripley
SOLAR PROJECT

**ConnectGen Chautauqua County LLC**

South Ripley Solar Project

Matter No. 21-00750

# 900-2.8 Exhibit 7

# Noise and Vibration

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# EXHIBIT 7 NOISE AND VIBRATION

## (a) Noise Impacts Study

Exhibit 7 contains a detailed analysis of the potential sound impacts associated with the construction and operation of the Project. Potential sources of sound from the Facility include the step-up transformer in the collection substation, electrical inverters and transformers within the various solar panel fields, HVAC equipment and inverters associated with the energy storage facilities, and temporary construction-related noise. As described in the Project Noise Impact Assessment (PNIA) (Appendix 7-A), this equipment generates sound, but sound generated by the Project meets all 94-c noise limits intended to protect neighboring residences, wildlife, and other sensitive receptors. There are no vibration issues associated with the operation of such a facility and vibration during construction is expected to be minimal.

The PNIA was prepared by Resource Systems Group, Inc. (RSG), a member of the National Council of Acoustical Consultants, under the direction of Kenneth Kaliski. Mr. Kaliski is Board Certified through the Institute of Noise Control Engineering and has 35 years of experience at RSG. He previously testified as an expert on Article 10 noise issues in such cases as Cassadaga Wind and Baron Winds.

## (b) Design Goals

Noise standards applicable to the Facility Site are described below and in Table 7-1. More information on these standards is included in Section 2 of the PNIA. Compliance with these standards is discussed below and in Table 7-2. The Facility has been designed to comply with all relevant design goals outlined in Table 7-1. There are no quantifiable local noise limits in the existing zoning law for the Town of Ripley. Although the Town of Ripley has proposed a potential amendment to the zoning law with a provision updating the noise requirements for solar facilities, as follows, the proposed amendment does not provide ascertainable noise limits:

*"J. Noise: Once in operation, sound pressure level at the exterior of any residence or nonparticipating property line, expressed in terms of dBA Leq-8hr, shall not exceed existing background ambient noise, expressed in dBA Leq-8hr as measured by a qualified acoustician, by more than 6dB "(Town of Ripley Planning Board, May 2021).*

This proposed amendment has not yet been signed into law and public comment on the proposed language is still pending, thus it is not yet applicable to the siting of the Project. A more detailed discussion of the proposed changes to the local zoning law can be found in Exhibit 24.

**Table 7-1. Facility Design Goals**

| Standard | Location | Maximum Sound Level |
|---|---|---|
| 900-2.7(b)(2)(i) | Outside of any existing non-participating residence | 45 dBA $L_{8h}$ |
| 900-2.7(b)(2)(i) | Outside of any existing participating residence | 55 dBA $L_{8h}$ |
| 900-2.7(b)(2)(ii) | Outside of any existing non-participating residence from the collector substation | 40 dBA $L_{1h}$ |
| 900-2.7(b)(2)(iii) | Outside of any existing non-participating residence | 5 dB penalty to the above limits for producing any audible prominent tones |
| 900-2.7(b)(2)(iv) | Short-term equivalent continuous average sound level from the facility across any portion of a non-participating property | 55 dBA $L_{8h}$ |

### (c) Radius of Evaluation

Evaluation of the maximum noise levels to be produced during operation of the Facility was conducted within the Sound Study Area which extends at a minimum, 1,500 feet from the edge of the Facility components or until the 30-dBA noise contour is reached, whichever is greater. Figure 7-1 identifies noise contours and all sensitive sound receptors and boundary lines (differentiating participating and non-participating parcels) and noise sources within the Sound Study Area including transformer(s), inverters, and other noise sources, if any).

A cumulative analysis requires modeling to include noise from any solar facility and substation existing and proposed by the time of filing the application and any existing sensitive receptors within a 3,000-foot radius from any noise source proposed for this Facility or within the 30 dBA noise contour, whichever is greater. There are no other solar facilities within 3,000 feet of a Project noise source or within the 30 dBA noise contour, so a cumulative analysis is not required.

### (d) Modeling standards, input parameters, and assumptions

The analysis performed to model the sound levels produced by the Project was performed utilizing the following parameters as required in Section 900-2.8(d) of the 94-c regulations. Future Project sound levels during construction and operation of the Facility were modeled in accordance with the standard ISO 9613-2, "Acoustics – Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation" for full octave bands from 31.5 Hz to 8000 Hz utilizing the Cadna/A acoustical modeling software from DataKustik GmbH. ISO 9613-2 assumes downwind sound propagation between every source and every receptor, consequently, all wind directions, including the prevailing wind directions, are taken into account. For solar facilities, the ISO 9613-2 model is more likely to overestimate sound levels. First, the barrier-effect of the solar panels in blocking sound from interior sources, especially inverters and medium-voltage transformers, was not taken into account in the modeling done for this Project. Second, sound emissions of solar equipment tend to be highest during sunny days. Under these conditions, the sound is refracted upwards, lowering the sound levels measured near the ground. Under the modeling assumptions used in this report, the meteorological conditions are always downward refracting, such as occurs during cloudy days with moderate downwind conditions or a well-developed moderate nighttime temperature inversion. No meteorological correction ($C_{met}$) was used. Additional model assumptions include the following:

- All noise sources operating simultaneously and at maximum sound power;
- The ground absorption factor was set to G=0.5 (half hard/half porous), except within the Project Battery Energy Storage System (BESS) facility fence line where the ground absorption factor was set to G=0 (hard ground) and the Project collection substation where the ground absorption factor was set to G=0.6 as dictated by Project design;
- Atmospheric attenuation calculated using a temperature of 10ºC and 70 percent relative humidity;
- A receptor height of 1.5 meters above ground; and
- No additional uncertainty adjustment added to or subtracted from the modeling results.

Noise standards applicable to the Facility Site, as well as noise guidelines that are required, or recommended, by various agencies, are described below. More information on these standards is included in Section 2 of the PNIA. Compliance with these standards is discussed below and in Table 7-2.

*Local Regulations*

The Town of Ripley regulates solar projects under its Solar Energy Law in Section 620 of the Zoning Ordinance. However, there is no quantitative noise limit identified. Please see Exhibit 24 for a comprehensive discussion of town requirements and potential amendments to Town of Ripley Zoning and quantitative noise limits.

*State Regulations*

The State of New York regulates noise from this Project under 94-c. The 94-c noise limits are shown in Table 7-1.

*Federal Standards and Guidelines*

No federal noise standards apply to solar power production or energy storage on private land.

Noise standards applicable to the Facility, are provided below in Table 7-2. The Facility has been designed to meet the existing Town and 94-c noise limits. As indicated in Table 7-2, the Facility is modeled as being in compliance with all of the standards applicable to the Facility.

**Table 7-2. Modeling Standards**

| Standard | Maximum Sound Level | Number of exceedances |
|---|---|---|
| 900-2.7(b)(2)(i) | 45 dBA $L_{8h}$ at non-participating residence | 0 (0%) |
| 900-2.7(b)(2)(i) | 55 dBA $L_{8h}$ at participating residence | 0 (0%) |
| 900-2.7(b)(2)(ii) | 40 dBA $L_{1h}$ from substation transformer | 0 (0%) |
| 900-2.7(b)(2)(iiI) | 5 dB penalty to the above limits for producing any audible prominent tones | All sources assumed tonal. With penalty applied 0 (0% of) homes exceed above limits |
| 900-2.7(b)(2)(iv) | 55 dBA $L_{8h}$ at non-participating property lines | 0 (0%) |

The maximum A-weighted overall sound levels for each sensitive sound receptor and most impacted property lines are found in Appendix C of the PNIA and presented in a spreadsheet compatible format. The maximum Z-weighted octave band sound levels, from 31.5 Hz to 8,000 Hz, are found in Appendix D of the PNIA. The number of receptors exposed to sound levels greater than 35 dBA are found in Table 8 of the PNIA. Sound contour maps are found in Figure 7-1. Within the PNIA, these maps are Figures 28 to 34 (in 1:12000 scale).

### (e) Evaluation of Prominent Tones for Design

Section 900-2.8 (b)(2)(iii) of the 94-c regulations requires an assumption of tonality for all sources for which 1/3 octave band data from the manufacturer is not available. In this case, this information is not available for any source. As such, all sources, including inverters, medium and high voltage transformers, and energy storage are assumed to be tonal and prominent according to ANSI/ASA S12.9-2005/Part 4 Annex C at the source and receiver. As such, a 5 dB penalty is applied to all sources after modeling.

### (f) Evaluation of Low Frequency Noise for Wind Facilities

The proposed Facility is not a wind facility and therefore the requirements of §900-2.7(f) are not applicable.

### (g) Evaluation of Infrasound for Wind Facilities

The proposed Facility is not a wind facility and therefore the requirements of §900-2.7(g) are not applicable.

### (h) Map of Study Area

A map of the Sound Study Area showing the location of sensitive sound receptors and boundary lines (differentiating participating [i.e., a contract has been signed with the Applicant prior to the date of Application filing], potentially participating, and non-participating parcels) within 1,500 feet of the proposed Facility components is provided in Figure 7-1. The figure also depicts all potential noise sources within the Sound Study Area, including transformer(s), inverters, the substation, and the energy storage structures. The sensitive sound receptors include all residences, outdoor public facilities and areas, hospitals, schools, libraries, parks, camps, summer camps, places of worship, cemeteries, Federal, State, and local Lands, and cabins and hunting camps identified by property tax codes that were identified within 1,500 feet of the Facility. Seasonal receptors included any other seasonal residences with septic systems/running water. All residences are included as sensitive sound receptors, regardless of participation in the project or occupancy (i.e., year-round and seasonal residences are included).

### (i) Ambient pre-construction baseline noise conditions

Pre-construction baseline noise conditions were evaluated using the $L_{90}$ statistical and the $L_{eq}$ energy-based noise descriptors, and by following the recommendations included in ANSI/ASA S3/SC1.100-2014-ANSI/ASA S12.100-2014 American National Standard entitled Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas. Sound level monitoring was performed for a total of approximately 15 days.

*Ambient Sound Monitoring Locations*

On behalf of the Applicant, RSG completed winter (leaf-off) and summer (leaf-on) background sound level monitoring at six representative locations distributed throughout the Facility Site. The monitoring locations were selected to be as representative as possible of the broader local soundscapes that exist in the immediate region. The various representative areas included rural residential, low and high traffic roads, and remote areas. Table 3 of the PNIA indicates the site characteristics of each monitoring location. Additional detail on each monitoring location is described in Section 5 of the PNIA.

*Ambient Sound Level Monitoring*

Background sound level monitoring was performed at these six locations during the winter of 2020 (March 4 to 12) and the summer of 2020 (July 9 to 16). Sound level data were collected using one to four Cesva SC310s, two to three Svantek 979, and zero to two Cirrus CR-171 Class 1 sound level meters, depending on the season, that continuously logged 1/3-octave band sound levels logged once each second. The microphones were fixed to temporary posts at a height of 1.2 meters (approximately 4 feet) above local grade. Each instrument was field calibrated before and after monitoring periods, with either a Cesva CB-5, Larson Davis CAL200, or Brüel Kjær 4231 calibrator. Additional detail is provided in Section 4 of the PNIA.

Statistical sound level data were averaged into 10-minute increments and summarized over the monitoring period. Statistical levels were calculated from the one-second equivalent continuous sound levels ($L_{1\text{-sec}}$). The 1/3 octave band spectra were also recorded at each location to document any pre-existing tonal sounds. Biogenic sounds, including insects, amphibians, and birds were excluded through the application of the "ANS" frequency-weighting network. If tones above 1.25 kilohertz (kHz) were detected, then the A-weighted sound level was recalculated by summing 1/3 octave bands from 20 Hz to 1.25 kHz, effectively removing the high-frequency portion of the sound. Additional detail on the background sound level monitoring methodology and data analysis is provided in Section 4.4 of the PNIA.

*Baseline Sound Monitoring Results*

Equivalent continuous sound levels, $L_{eq}$, are the energy-average level over a period of time. The 10$^{th}$ percentile sound levels ($L_{90}$) are the statistical value above which 90% of the sound levels occurred during an interval.

The sound levels for the winter and summer monitoring periods for all six sites are summarized in Tables 4 to 6 of the PNIA. Except for the substation location, the nighttime $L_{eq}$s are less than the daytime levels, which is typical and indicates a diurnal pattern. The difference between the overall $L_{eq}$ and overall $L_{90}$ for each site ranged from 10 dB to 19 dB. A larger difference between the $L_{eq}$ and $L_{90}$ indicates that the soundscape is more likely to include transient or intermittent sounds, such as aircraft overflights or passing automobiles and farm equipment. Graphical timelines for the A-weighted $L_{eq}$ and $L_{90}$ broadband noise levels for both summer and winter monitoring at each monitoring location are found in Section 5 of the PNIA.

### (j) Construction Noise

In contrast to other forms of power generation, the duration of the construction phase for a PV solar facility is short and the activities that generate significant noise are few. Where a fossil fuel or wind generating project would require the pouring of concrete foundations and the delivery and assembly of very large components, construction of a solar facility largely involves the installation of mounting posts for the PV panel racking, manual installation of the individual panels, some grading and earthwork, erection of the collection substation and energy storage facility, and collection line trenching. The duration of the construction phase for the Facility is anticipated to require approximately 19 months, although the activities that generate any significant sound are few and not anticipated to exceed the full phase of construction. Construction of the Facility is proposed to take place from 7:00 AM to 6:00 PM Monday through Saturday. While some activities may take place on occasional Sundays, pile driving will be restricted to Monday through Saturday.

Noise resulting from construction was modeled with ISO 9613-2, *Acoustics – Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation* (ISO 9613-2) 3-D sound propagation standard as implemented in the Cadna/A software package. Sound source information was obtained from the Federal Highway Administration's (FHWA) Roadway Construction Noise Model and manufacturer data. For construction noise modeling, construction activities were categorized into seven groups: road construction, substation and energy storage construction, trenching, array inverter construction, piling, racking, and boring. The closest receptors were identified and the worst-case areas around the Facility Site were modeled assuming the maximum sound emissions of all associated construction equipment operating simultaneously.

All operational modeling standards, input parameters, and assumptions followed those outlined in (d) above. The results of the construction noise modeling are summarized below and are provided in additional detail in Section 7 of the PNIA.

- Facility road construction would take place within and adjacent to the solar arrays. The primary noise sources associated with this activity are excavators, dozers, graders, dump trucks, and rollers. The cumulative maximum modeled sound results of all primary road construction sources operating simultaneously near the closest receptor (Receptor ID 38) is 83 dBA. See Figure 35 and Table 9 of the PNIA.

- The primary sources of noise associated with the construction of the substation and energy storage facility are excavators, dozers, graders, dump trucks, rollers, concrete mixing trucks, concrete pumper trucks, flatbed trucks, man-lifts, and large and small cranes. The cumulative maximum modeled sound results of all primary substation and energy storage construction sources operating simultaneously near the closest receptor (Receptor ID 42) is 72 dBA. See Figure 36 and Table 10 of the PNIA.

- Trenching would take place along the underground collection line routes throughout the Facility Site. The primary noise sources associated with this activity are excavators, dozers, rollers, compactors, flatbed trucks, forklifts, and trenchers. The cumulative maximum modeled sound results of all primary trenching sources operating simultaneously near the closest receptor (Receptor ID 38) is 83 dBA. See Figure 37 and Table 11 of the PNIA.

- Array inverter and transformer construction would take place at pads throughout the solar arrays. The primary noise sources associated with this activity are excavators, dozers, graders, rollers, dump trucks, concrete mixing trucks, and concrete pumping trucks. The cumulative maximum modeled sound results of all primary construction sources operating simultaneously during this phase near the closest receptor (Receptor ID 25) is 72 dBA. See Figure 38 and Table 12 of the PNIA.

- Piling would take place throughout the solar arrays. The primary noise sources associated with this activity are flatbed trucks, boom trucks, and pile drivers. The cumulative maximum modeled sound results of all primary piling sources operating simultaneously near the closest receptor (Receptor ID 92) is 73 dBA. See Figure 39 and Table 13 of the PNIA.

- Racking would take place throughout the solar arrays. The primary noise sources associated with this activity are flatbed trucks and forklifts. The cumulative maximum modeled sound results of all primary racking sources operating simultaneously near the closest receptor (Receptor ID 92) is 78 dBA. See Figure 40 and Table 14 of the PNIA.

- Boring would take place along portions of the underground collection line routes throughout the Project area and would primarily involve the use of a boring machine. Boring typically only lasts one to three days in any given location, so the potential impacts are relatively short-lived. The maximum modeled sound results of boring near the closest receptor (Receptor ID 38) is approximately 50 dBA. See Figure 41 and Table 15 of the PNIA

### (k) Sound Levels in Graphical Format

As described above, Figure 7-1 depicts sound contours, all sensitive sound receptors and boundary lines, and all noise sources from the Facility at a scale of 1:12,000. Sound contours are rendered at least until the 30 dBA noise contour is reached, in 1 dBA steps with sound contour multiples of 5 dBA differentiated. Similarly scaled maps are also shown in the PNIA in Figures 28 to 34 and full-size hard copy maps (22” x 34”) will be submitted to ORES.

### (l) Maximum sound impacts

The sound propagation modeling done in the PNIA assumes the sun is always shining during the daylight hours and that the sunlight is always strong enough to generate the maximum power of the Facility, at the same time the energy storage units are continuously fully charging or discharging over an eight-hour period. These are conservative assumptions not representative of actual project operating conditions. However, for the purposes of this modeling exercise it represents a worst-case evaluation. Sound levels from the Project will likely be lower for most of the time, as the sun is not always shining, the HVAC on the energy storage is not always running at 100% output, meteorological conditions are not always favorable for propagation[1], and the solar panels will act, to some extent, as sound barriers.

[1] Sound propagates relatively poorly on sunny days relative to cloudy days or nighttime conditions.

The A-weighted sound levels at the sensitive sound receptors, for the operating Facility are provided in Table 7-3 below as a tabular comparison between maximum sound impacts and state requirements (standards) for the Facility (see Table 7-2).

**Table 7-3. Modeled Sound Level Results**

| | Minimum | Maximum | Average |
|---|---|---|---|
| **Non-participating residence** | 30 dBA | 44 dBA | 38 dBA |
| **Participating residence** | n/a | 52 dBA | n/a |
| **From substation transformer** | n/a | 34 dBA | n/a |
| **Tonal penalty applied to the above** | +5 dB | +5 dB | +5 dB |
| **Non-participating property line** | n/a | 52 dBA | n/a |

The maximum sound impacts, compared with the Project design goals, are shown in Table 7-4, below.

**Table 7-4. Modeled Sound Level Results Compared with Design Goals**

| | Maximum | Plus 5 dB Tonal Penalty | Standard | Standard met? |
|---|---|---|---|---|
| **Non-participating residence** | 39 dBA | 44 dBA | 45 dBA | Yes |
| **Participating residence** | 47 dBA | 52 dBA | 55 dBA | Yes |
| **From substation transformer** | 34 dBA | 39 dBA | 40 dBA | Yes |
| **Non-participating property line** | 52 dBA | n/a | 55 dBA | Yes |

The maximum sound levels at 1/1 octave bands are shown in Table 7-5, below.

**Table 7-5. Maximum Modeled Octave Band Sound Level Results at a Sensitive Receptor**

| 1/1 Octave Band Sound Pressure Level (dBZ), Maximum $L_{8h}$ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 31.5 Hz | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1 kHz | 2 kHz | 4 kHz | 8 kHz |
| 55 | 47 | 48 | 51 | 45 | 39 | 35 | 28 | 17 |

## (m) Potential community noise impacts

### (1) Potential for Hearing Damage

The Facility's potential to result in hearing damage was evaluated against three guidelines established by the Occupational Safety and Health Administration (OSHA) and World Health Organization (WHO). Comparison of sound propagation modeling to these guidelines shows that construction and operation of the Facility will not result in potential for hearing damage. Each of these 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 eight-hour day are 90 dBA. At sound levels above 85 dBA over an eight-hour workday, employers shall provide hearing protection to employees. Sound pressure levels, as generated by Facility construction and operation at sensitive sound receptors, will be under this threshold, so the Facility will be in compliance with OSHA standards. Therefore, based on the OSHA standard, the Facility will not result in potential for hearing damage.

The WHO long-term guideline to protect against hearing impairment is 70 dBA $L_{eq\text{-}24h}$ over a lifetime exposure, and 120- and 140-dB peak sound levels for impulsive sounds (e.g., blasting) for children and adults, respectively. No blasting will be required for the construction of the Facility, and construction noise levels at the closest receptors were modeled well below the 120- and 140-dB thresholds. In addition, the operation of the Facility will not produce noise levels over 70 dBA $L_{eq\text{-}24h}$. Therefore, there is no potential for hearing impairment from construction or operation of the Facility.

**(2) Potential for Structural Damage**

As previously indicated, at this time, blasting activities are not anticipated during construction of the Facility. It is also not anticipated that any other construction activities (such as excavation, pile driving, boring, or rock hammering) will produce any cracks, settlements, or structural damage to existing proximal buildings or infrastructure, including any residences or historic buildings.

### (n) Noise Abatement Measures for Facility Construction

A Draft Complaint Management Plan has been prepared for the Facility in accordance with pre-construction compliance filings under 19 NYCRR 900-10.2(e)(7). Please see Appendix 7-B. The Draft Complaint Management Plan will detail the process for receiving and resolving any complaints received during construction and operation of the Facility, including any noise and vibration complaints. A Final Complaint Management Plan will be filed as a pre-construction compliance filing under 19 NYCRR 900-10.2(e)(7).

The Applicant takes seriously any reasonable complaints that it receives from members of the public. The Draft Plan details instructions for registering complaints, including via phone, writing, or email. The Applicant will also implement a comprehensive complaint response procedure and timeline, which may include community engagement, gathering information, investigation, 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.

Although impacts related to construction noise will be temporary, and are not anticipated to be significant, measures employed to minimize and mitigate temporary construction noise may include:

- Utilizing construction equipment fitted with proper functioning exhaust systems and mufflers,
- Locating all stationary noise-generating equipment, such as air compressors and portable power generators, a minimum of 200 feet from adjacent residential structures,
- Maintaining equipment and surface irregularities on construction sites to prevent unnecessary noise,
- To the extent feasible, configuring the construction in a manner that keeps loud equipment and activities as far as possible from noise-sensitive locations,
- Developing a staging plan that establishes equipment and material staging areas at least 200 feet away from sensitive receptors when feasible,
- Requiring contractors to use approved haul routes to minimize noise at residential and other sensitive noise receptor sites, and
- Prohibiting unnecessary idling of internal combustion engines.

### (o) Noise Abatement Measures for Facility Design and Operation

Adverse noise impacts will be avoided or minimized through careful siting of Facility components, the use of alternative designs, and alternative technologies. Noise abatement measures proposed for the Facility are generally centered around the energy storage facility and include the use of low-noise condenser fans on the air handling units. No noise barriers are currently proposed, and no noise mitigation measures are required based on the current Project design.

### (p) Software Input Parameters

Specific modeling parameters are included as Appendix B of the PNIA prepared by RSG. GIS files containing modeled topography, noise source and sensitive sound receptor locations, and all external boundary lines identified by Parcel ID number are being provided to ORES under separate cover in digital format. Similarly, the Cadna/A computer noise modeling files are being provided to ORES in digital format. Substation site plan and elevation details are provided in Appendix 5-D.

The locations of all noise sources are identified in Figures 7-1 and GIS coordinates are provided to ORES under separate cover in digital format. Sound information from the manufacturers for all noise sources included in this analysis are presented in Appendix B of the PNIA (Appendix 7-A)

## (q) Miscellaneous

1) A glossary of terminology, definitions, abbreviation, and references is included in Appendix F of the PNIA.

2) As previously noted, sound monitoring information will be provided to ORES in a spreadsheet compatible format under separate cover and will be presented in accordance with the requirements outlined in Section 900-2.8(q)(2). The number of sensitive receptors exceeding design goals is shown in Table 16 of the PNIA. No sensitive sound receptors are modeled to be exposed to Project sound levels that exceed design goals or noise limits. The number of receptors at sound levels above 35 dBA, in 1 dB bins, is shown in Table 8 of the PNIA.

## REFERENCES


International Organization for Standardization (ISO). 1989. *ISO 9613-2 Acoustics – Attenuation of Sound During Propagation Outdoors,* Part 2, "A General Method of Calculations." ISO 9613-2, Geneva, Switzerland, 1989.

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World Health Organization (WHO). 1999. *Guidelines for Community Noise*.

WHO. 2009. *Night Noise Guidelines for Europe.*