September 24, 2020

Gina L. Wolfman
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Re: Environmental Noise Study
Greenskies – Elmridge Golf Course PV Solar Facility
Stonington, CT

TECHNICAL MEMORANDUM

Dear Ms. Wolfman,

At your request, SLR International Corporation (SLR) has performed an environmental noise study and analysis for the Elmridge Golf Course PV Solar Facility. The purpose of the study was to predict the expected sound levels due to the facility at the property lines of nearby residences.

1. ENVIRONMENTAL SOUND LEVEL CRITERIA

SLR is not aware of any specific noise ordinances for the City of Stonington that apply to this project. The Connecticut Department of Energy and Environmental Protection (DEEP) has a statewide noise regulation that serves in lieu of a local ordinance when there is not one present. The regulation limits continuous noise, defined as "ongoing noise that remains at a measurable level of intensity without interruption over an indefinite or specified period of time"[1]. The DEEP regulation limits continuous noise to the levels shown in **Table 1** at the receiving property line.

Table 1: Connecticut DEEP Noise Regulation Limits

Emitter Class	Receptor Zone	Hours	Maximum Permitted Noise Level, dBA
Commercial	Residential	Daytime (7AM – 10PM)	55
		Nighttime (10PM – 7AM)	45
	Commercial	All Times	62

[1] Connecticut Department of Environmental Protection, Sec. 22a-69-1.2 and 22a-69-3.5

2. PROJECT DESCRIPTION

Site

The Elmridge Golf Course PV Solar Facility site is at the south side of Elm Ridge Road and west side of N Anguilla Road in Stonington, Connecticut. The site has neighboring residential areas in every direction. The solar facility will be built on two sites across the golf course. One site will be built east of N Anguilla while the second will be built west of the road.

Project Equipment

The facility is scheduled to generate a total of 3000 kW AC across the entire facility divided among three 1,000 kW systems. The west site will consist of a single system comprising 3,200 395W solar modules, 8 128kW inverters, and 1 1000kVa, 15 kV liquid filled transformer. The east site will comprise two 1,000 kW systems. The transformers for each system will be located on an equipment pad while the inverters will be located at the end of module rows whenever possible.

3. SOUND LEVEL MEASUREMENTS

Marc Mancini and Windsor Francis of SLR performed short-term handheld sound level measurements at the site on September 11, 2020. The purpose of the measurements was to document existing environmental sound levels at the residential neighborhood adjacent to the project area. The measurements were taken at three different locations across the site. The project site and measurement locations are shown in **Map 1**, attached.

Measurement Instrumentation

Sound level equipment used during the site survey included the following instruments:

- Larson Davis Model 831 SLM, Serial number 2443; Type 1
- Larson Davis CAL200 pure tone calibrator

A windscreen was used on the measurement microphone. The sound level meter was field-calibrated before and after measurements. All instrumentation has current laboratory certification.

Weather Conditions

Weather was appropriate for a sound level survey. The temperature ranged from approximately 66°F to 70°F during the measurement survey. The skies varied from partly cloudy to partly sunny. Wind speed ranged from 10.4 to 10.8 mph and was generally from the northeast. The relative humidity ranged from approximately 766 to 71 percent. The ground conditions at the site were dry.

Ambient Monitoring Results

Results from the sound level measurements are shown in **Table 2**, below. Noise from traffic on nearby Interstate 95, local traffic, and golf course activities were audible at all measurement locations.

Table 2: Environmental Measurement Results

Location Description	Total Period Average (L_{eq}) dBA	Maximum Sound Level Recorded (L_{max}) dBA	Sound Level Exceeded 10% of the Period (L_{10}) dBA	Sound Level Exceeded 50% of the Period (L_{50}) dBA	Sound Level Exceeded 90% of the Period (L_{90}) dBA
Northern Property Boundary	53.1	68.9	56.1	48.1	45.7
Western Property Boundary	50.5	61.3	53.7	48.5	46.2
Southern Property Boundary	45.7	57.7	46.8	45.5	44.4

4. NOISE IMPACT EVALUATION

Noise Model Development

A three-dimensional computer noise model was constructed to estimate the noise contribution of the Elmridge facility on nearby residences. Incorporating the architectural site plan, the model was developed using Cadna/A, version 2020 MR1 build 177.5010, a commercial noise modeling package developed by DataKustik GmbH. The software takes into account spreading losses, ground and atmospheric effects, shielding from barriers and buildings, reflections from surfaces, and is based on published engineering standards. The ISO 9613[2] standard was used for air absorption and other noise propagation calculations.

A temperature of 20°C and 70 percent relative humidity were used for the atmospheric absorption calculations in the model.

Data and Assumptions

Sound power levels for the transformers were calculated based on the National Electrical Manufacturer's Association (NEMA) maximum allowable levels. Sound power levels for the proposed inverters were calculated based on the specified sound pressure level of 56 dBA at 3 meters. **Table 3**, below, lists all the sound power levels used in the noise model, as well as the source for the data.

Table 3: Modeled Sound Power Levels

Equipment	Linear Decibels at Octave Band Frequencies									Overall A-wtd	Source Material
	31.5	63	125	250	500	1k	2k	4k	8k	dBA	
Inverters	106.1	95.1	81.1	74.1	69.1	64.1	59.1	56.1	53.1	**74.4**	**Spec Sheets**
Transformers	103.4	93.4	83.4	73.4	68.4	63.4	58.4	53.4	50.4	**73.6**	**NEMA TR-1-1993**

[2] ISO 9613, "Acoustics – Attenuation of sound during propagation outdoors," 1996.

Sound power levels were calculated assuming that one transformer and 8 inverters were running continuously in each section of the facility. As inverter locations will be determined during construction, their sound powers were spread out across each of the facility areas.

Noise Model Results

Table 4 shows a summary of the predicted sound level contributions at each property line. The total predicted sound levels including the solar facility contribution and ambient and the predicted increase are shown. This table indicates that the sound level contribution from the proposed solar facility will be below the DEEP noise criteria at all property lines. **Figure 1**, attached, shows the predicted sound levels from the facility as lines of constant sound level overlaid on an aerial photograph of the site.

Table 4: Elmridge Facility Noise Impact on Residences

Property Line Direction	Nearest Affected Property Address	DEEP Maximum Permissible Night Sound Levels, dBA	Measured Existing Sound Level Average, dBA	Estimated Contribution of Facility, dBA	Combined, All Sources Including Ambient, dBA	Increase Above Ambient, dB
			L_{eq}	L_{eq}	L_{eq}	ΔL_d
North	224 Elmridge Rd	45.0	53.1	**34.1**	53.2	0.1
West	139 N Anguilla Rd	45.0	50.5	**35.0**	50.6	0.1
South	6 Woodland Way	45.0	45.7	**30.1**	45.8	0.1

The predicted sound levels from the facility range from 30.1 to 35.0 dBA at the closest property lines. These are very low sound levels, and are similar to those present in a quiet library or very quiet rural area far from any highways or local traffic.

Most people consider a change in sound level of three decibels to be barely perceptible. The predicted increases of 0.1 dB for this facility would not be perceptible. During most of the time, noise from the facility will not be audible at the surrounding property lines due to ambient noise from nearby Interstate 95.

5. CONCLUSION

Sound level measurements of the existing ambient environment were taken at the Elmridge Golf Course in Stonington, Connecticut. The measured levels were used to assess the impact of a proposed PV Solar Facility to be built at that location. A computer-generated noise model determined the predicted acoustical contribution from the facility at all directional property lines.

The noise model predicts that the sound levels from the facility will range from 30.9 to 35.0 dBA at the closest property lines. These levels are below the Connecticut Department of Energy and Environmental Protection noise regulation limits. The predicted increase in sound levels due to facility noise is about 0.1 dB, an imperceptible change.

This concludes our Technical Memorandum. Please contact me if you have any questions.

Sincerely,
SLR International Corporation

David M. Jones, P.E., INCE Bd. Cert.
Principal Engineer

DMJ/slj

Enc Map 1
Figure 1

LIMITATIONS

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Map 1: Measurement Locations

Figure 1: Predicted Sound Level Contribution of Project Equipment