Acoustical Study

Pompeo Road Solar

Pompeo Road
Thompson, CT

PREPARED FOR

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Introduction

The purpose of this acoustical study is to evaluate the potential noise impacts associated with the operation of the proposed C-TEC Solar LLC, Pompeo Road Solar Project (the Project) located along Pompeo Road in Thompson, Connecticut. This acoustical assessment evaluated the potential sound levels generated by the mechanical equipment, including the inverters and a transformer, that will be part of the Project. The acoustical assessment was based on the site plans titled Pompeo Solar, dated January 2, 2025, prepared by VHB. The sound levels were compared to the Connecticut Department of Energy and Environmental Protection's (CT DEEP) noise control regulations (Regulations of Connecticut State Agencies (RCSA), Title 22a, Section 22a-69-1 to 22a-69-7).

Project Description

The proposed Project consists of the development of an approximately 3.0-Megawatt (MW) alternating current (AC) ground-mounted solar photovoltaic (PV) facility located on an approximately 12-acres on Pompeo Road in Thompson, Connecticut (M/B/L 81-48-17). This parcel is referred to herein as the Project Site.

Fundamentals of Noise

Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities such as sleep, communication, work, or recreation. How people perceive sound depends on several measurable physical characteristics, which include the following:

› **Intensity** – Sound intensity is often equated to loudness.
› **Frequency** – Sounds are comprised of acoustic energy distributed over a variety of frequencies. Acoustic frequencies, commonly referred to as tone or pitch, are typically measured in Hertz. Pure tones have all their energy concentrated in a narrow frequency range.

Sound levels are most often measured on a logarithmic scale of decibels (dB). The decibel scale compresses the audible acoustic pressure levels which can vary from the threshold of hearing (zero dB) to the threshold of pain (120 dB). Because sound levels are measured in dB, the addition of two sound levels is not linear. Adding two equal sound levels creates a 3 dB increase in the overall level. Research indicates the following general relationships between changes in sound level and human perception:

- A 3 dB increase is a doubling of acoustic energy and is the threshold of perceptibility to the average person.
- A 10 dB increase is a tenfold increase in acoustic energy but is perceived as a doubling in loudness to the average person.

The human ear does not perceive sound levels from each frequency as equally loud. To compensate for this phenomenon in perception, a frequency filter known as A weighted [dB(A)] is used to evaluate environmental noise levels. **Table 1** presents a list of common outdoor and indoor sound levels.

Table 1. Common Outdoor and Indoor Sound Levels

Outdoor Sound Levels	Sound Pressure (μPa)*		Sound Level dB(A)**	Indoor Sound Levels
	6,324,555	-	110	Rock Band at 5 m
Jet Over Flight at 300 m		-	105	
	2,000,000	-	100	Inside New York Subway Train
Gas Lawn Mower at 1 m		-	95	
	632,456	-	90	Food Blender at 1 m
Diesel Truck at 15 m		-	85	
Noisy Urban Area—Daytime	200,000	-	80	Garbage Disposal at 1 m
		-	75	Shouting at 1 m
Gas Lawn Mower at 30 m	63,246	-	70	Vacuum Cleaner at 3 m
Suburban Commercial Area		-	65	Normal Speech at 1 m
	20,000	-	60	
Quiet Urban Area—Daytime		-	55	Quiet Conversation at 1 m
	6,325	-	50	Dishwasher Next Room
Quiet Urban Area—Nighttime		-	45	
	2,000	-	40	Empty Theater or Library
Quiet Suburb—Nighttime		-	35	
	632	-	30	Quiet Bedroom at Night
Quiet Rural Area—Nighttime		-	25	Empty Concert Hall
Rustling Leaves	200	-	20	
		-	15	Broadcast and Recording Studios
	63	-	10	
		-	5	
Reference Pressure Level	20	-	0	Threshold of Hearing

Source: Highway Noise Fundamentals. Federal Highway Administration, September 1980.

* mPA – MicroPascals, which describe pressure. The pressure level is what sound level monitors measure.

** dB(A) – A weighted decibels, which describe sound pressure logarithmically with respect to 20 mPa (the reference pressure level).

A variety of sound level indicators can be used for environmental noise analysis. These indicators describe the variations in intensity and sequential pattern of the sound levels. The indicators used in this analysis are defined as follows:

- Leq is the equivalent continuous A-weighted sound level, which is the value or level of a steady, non-fluctuating sound with the same acoustic energy as the actual time-varying sound levels over a given time period.

- L10 is the A-weighted sound level, which is exceeded for 10 percent of the time over a given time period.
- L90 is the A-weighted sound level, which is exceeded for 90 percent of the time over a given time period. The L90 is generally considered to be the background sound level.

Noise Impact Criteria

The CT DEEP has developed noise impact criteria that establish sound level thresholds deemed to prevent adverse impacts for new developments. The acoustic analysis for the Project used these criteria to evaluate whether the Project will generate sound levels that result in adverse impacts.

The CT DEEP's noise control regulations identify the limits of sound that can be emitted from specific premises and what activities are exempt. The noise control regulations (Title 22a, §§ 22a-69-1 to 22a 69-7) are contained in the RCSA. The proposed Project is considered a Class C (Industrial) emitter by the CT DEEP. Nearby residences are Class A (Residential) Receptors. The land use in Class A noise zone is characterized as generally residential where human beings sleep, or areas where serenity and tranquility are essential to the intended use of the land.

The CT DEEP policy states that a source (emitter) located in the various zones shall not emit noise exceeding the levels stated in **Table 2** at the adjacent noise zones.

Table 2. Noise Zone Standards (dB(A))

	Receptor Noise Zone			
Emitter Zone	Class A (Daytime)	Class A (Nighttime)	Class B	Class C
Class A (Residential)	55	45	55	62
Class B (Commercial)	55	45	62	62
Class C (Industrial)	61	51	66	70

Source: Control of Noise (Title 22a, Section 22a-69-1 to 22a-69-7.4), RCSA, Revised 2015-3-6.

The CT DEEP's noise regulation includes a prominent discrete tone criteria which identifies limits which each one-third octave band center frequency should not exceed any adjacent one-third octave band center frequency (Title 22a, §§ 22a-69-1.2(r)). The manufacturer specifications for the proposed equipment did not provide one-third octave band sound levels. As such, a 5 dBA penalty was applied to the criteria to conservatively evaluate the potential for tonal noise from the facility.

The noise control regulations (Title 22a, §§ 22a-69-3.6) take into consideration projects that are to be located in areas with high existing background noise. For such areas, the noise emitted by the project sources are considered to cause excessive noise if they emit levels 5 dB(A) above the background noise. It was conservatively assumed that existing sounds levels in this area would not be above the CT DEEP criteria; as such, the sound levels in **Table 2,** with a 5 dBA penalty for tonal noise would be applicable to this Project. The town of Thompson does not have a noise ordinance, therefore, the project will be subject to CT DEEP's noise regulation and limited to 56 dBA daytime and 46 dBA nighttime sound level limits.

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Acoustical Assessment

Methodology

This acoustical assessment evaluated the sound levels from the Project's proposed mechanical equipment. The Project's noise sources consist of twenty-four electrical inverters used to convert the solar energy to usable electricity and one transformer. Equipment locations are presented in **Figure 1**.

The Project-generated sound levels were calculated using manufacturer's sound data and the principles of acoustical propagation of sound over distance and were calculated for each sensitive receptor location. The sources of operational noise associated with the proposed project include:

› Twenty-four (24) CPS 100/125 kW, 1500 Vdc String inverters and

› One (1) 3,000 kVA transformer.

The sound power level data for these pieces of equipment are provided in **Table 3**. The sound power level for the inverters was based on the manufacturer's specifications. The reference sound levels for the transformers are based on an empirical approach obtained from the literature that relates the kVA-rating of an air-cooled transformer to its sound power level.[1] See **Attachment A** for manufacturer's specifications.

Table 3. Modeled Sound Power Levels

		Sound Power Levels (dB) by Octave Band Center Frequency (Hz)								Overall	
Equipment	**Qty**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**dB(A)**	**dB**
CPS inverter[1]	24	--	--	--	76	--	--	--	--	73	76
3000 kVA transformer[2]	1	84	88	82	78	78	72	67	61	83	92

1 CPS 100/125 kW, 1500 Vdc String Inverters for North America.
2 Barron, 2003.

[1] Barron, Randall F., "Industrial Noise Control and Acoustics," Marcel Dekker, Inc., Table 5-7, pp. 177-178, 2003.

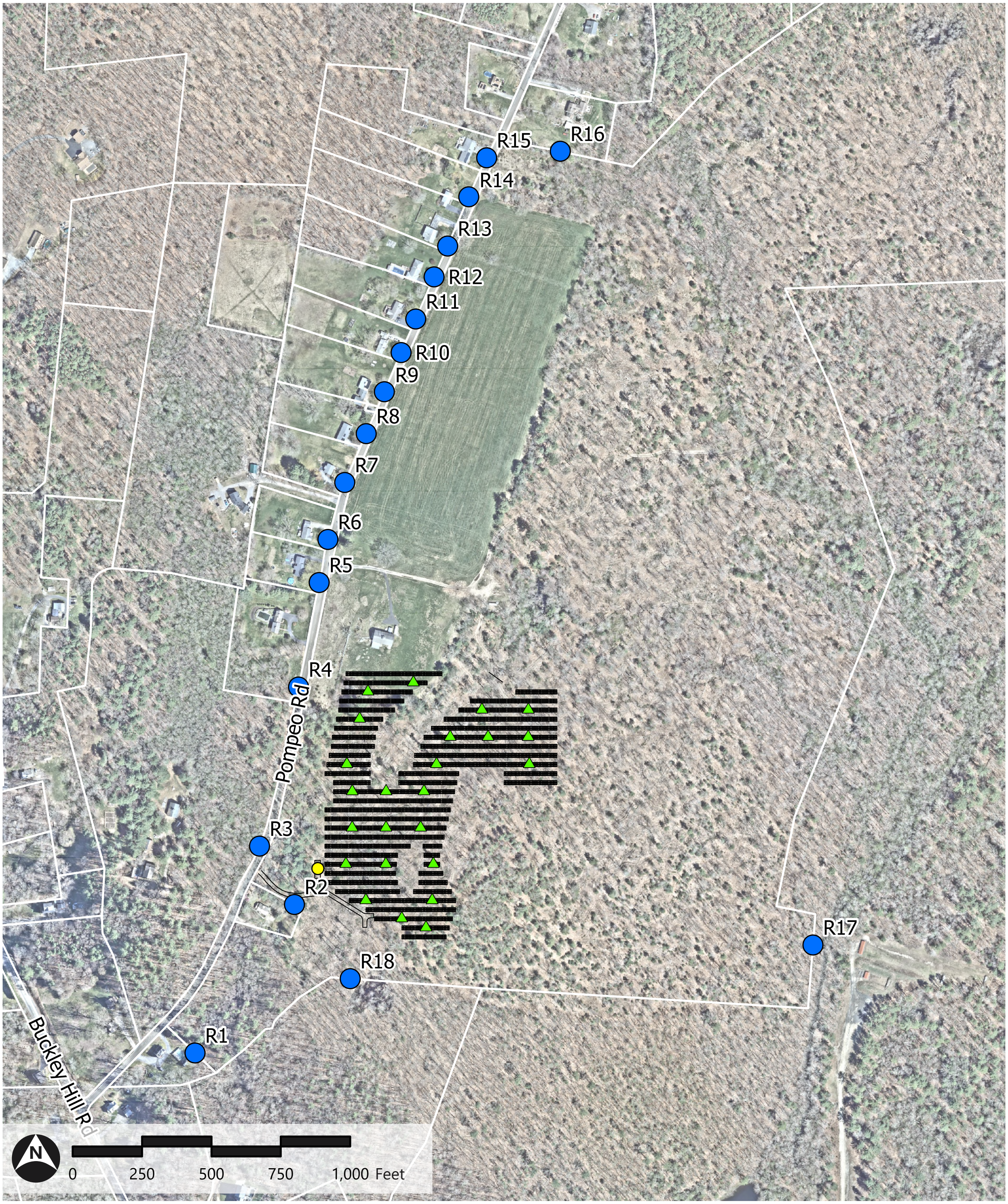
The A-weighted sound pressure levels due to the operation of the Project were predicted at the receptor locations using the acoustic modeling software CadnaA[2] (Computer Aided Noise Abatement) by Datakustik. CadnaA is an internationally accepted sound prediction program that implements the International Standards Organization (ISO) 9613-2 (2024) outdoor sound propagation standard. The noise prediction model accounts for the sound emissions of equipment, the ground cover, terrain, and the geometry of the project area. The assessment assumed all equipment operating simultaneously during the daytime period. Sound propagation was assumed to occur over acoustically “soft” ground (G=1.0). The ground at the equipment pad – the location at which the inverters and transformers would be installed – was assumed to be acoustically “hard” ground (G=0.0). Nearby roadways and other paved areas were also assumed to be acoustically “hard” ground. The ISO standard conservatively assumes there are moderate downwind conditions where the wind would blow from the source to each receptor location. Receptors were modeled at a height of 1.5 m (5-feet) above the ground at the nearest property lines to the equipment. The noise prediction model did not account for excess attenuation provided by trees, or by any on-site or off-site structures, lending some conservatism to the results. The results were compared to the CT DEEP noise impact criteria for determining compliance.

Receptor Locations

A total of eighteen receptor locations were identified in the vicinity of the Project Site (see **Figure 1**). The receptor locations were selected based on their proximity to the Project Site and their land use. These receptor locations represent the nearest property lines of the Project and nearest residential property lines.

[2] DataKustik GmbH, 2024. Computer Aided Noise Abatement Model.

Figure 1. Noise Receptor and Equipment Locations



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Receptors

Equipment

Inverter

Transformer

Figure 1: Noise Receptor and Equipment Locations

Pompeo Solar

Thompson, Connecticut

January 2, 2025

Source: NearMap, and VHB 2024.

Future Conditions

VHB evaluated the potential sound level impacts associated with the Project's proposed mechanical equipment at the nearby sensitive receptor locations. This analysis evaluated the potential sound level impacts from the twenty-four inverters and one transformer operating simultaneously.

The potential sound levels associated with the proposed equipment were determined by comparing the predicted Project generated sound levels to CT DEEP's noise standards with a 5 dBA penalty applied for potential tonal noise from the proposed mechanical equipment. The results of the acoustical analysis demonstrated that the operation of the proposed equipment will comply with CT DEEP's noise standards at the sensitive receptor locations. The sound levels attributed to the proposed equipment range from approximately 6 dB(A) at Receptor R17, the eastern property line, to 35 dB(A) at Receptor R2, 35 Pompeo Road located to the south. These sound levels are below CT DEEP's daytime criteria of 56 dB(A) and the nighttime criteria of 46 dB(A) with a 5 dBA penalty applied for potential tonal noise. Due to the nature of the Project, the solar equipment will not be operating during the nighttime period and therefore would not make noise during the nighttime. However, the nighttime criteria comparison has been included for information purposes to demonstrate compliance. **Table 4** summarizes the sound levels due to the operation of the inverters and transformers at the receptor locations.

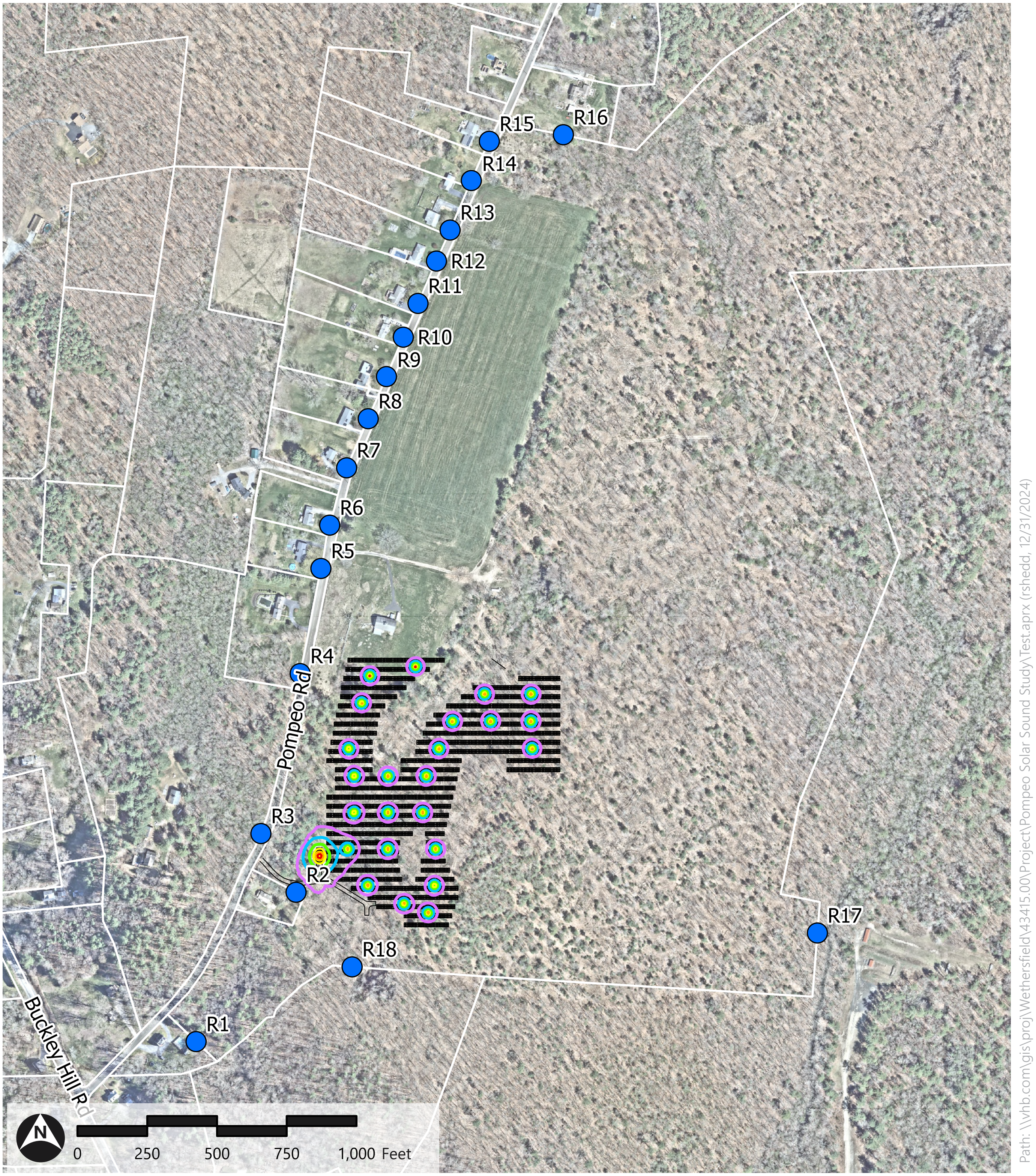
Table 4. Daytime Sound Levels at Receptor Locations, dB(A) – Due to Inverters and Transformer

Receptor Locations	CT DEEP Noise Standard* (Daytime/Nighttime)	Project Generated Sound Levels
R01 - 9 Pompeo Road	56/46	24
R02 - 35 Pompeo Road	56/46	35
R03 - 36 Pompeo Road	56/46	28
R04 - 78 Pompeo Road	56/46	27
R05 - 88 Pompeo Road	56/46	23
R06 - 96 Pompeo Road	56/46	22
R07 - 104 Pompeo Road	56/46	20
R08 - 110 Pompeo Road	56/46	18
R09 - 116 Pompeo Road	56/46	17
R10 - 124 Pompeo Road	56/46	16
R11 - 130 Pompeo Road	56/46	17
R12 - 136 Pompeo Road	56/46	15
R13 - 142 Pompeo Road	56/46	16
R14 - 148 Pompeo Road	56/46	14
R15 - 154 Pompeo Road	56/46	14
R16 - 159 Pompeo Road	56/46	10
R17 - 65 Valley Road (Eastern Property Line)	56/46	6
R18 - 130 Buckley Hill Road	56/46	28

* Noise standard for Class C emitter and Class A receptor, unless otherwise noted.
CT DEEP noise standard with 5 dBA penalty applied.

Figure 2 presents sound level contours (i.e., lines of equal sound level that are analogous to topographic contours that are lines of equal ground elevation) for the operation of the inverters and transformers. The sound level contours in **Figure 2** excludes contributions from off-site sources of sound.

Figure 2. Modeled Sound Level Contours with Transformers and Inverters



Sound Level Contours

Receptors

41 dBA

46 dBA*

51 dBA

56 dBA**

61 dBA

66 dBA

** CTDEEP Nighttime Standard; ** CTDEEP Daytime Standard*

Figure 2: Modeled Sound Level Contours with Transformer and Inverters

Pompeo Solar
Thompson, Connecticut
January 2, 2025

Source: NearMap, and VHB 2024.

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Findings

Conclusion of Acoustical Assessment

In this acoustical analysis, VHB evaluated the sound levels associated with the Project's mechanical equipment which includes 24 inverters and one transformer. This analysis conservatively assumed that the properties abutting the Project Site currently experience sound levels below CT DEEP's noise standards and the high background noise areas guidance (Sec 22a-69-3.6) do not apply to the Project. Additionally, the project conservatively assumed a 5 dBA penalty for the potential tonal noise generated by the proposed mechanical equipment.

Due to the low noise equipment and sufficient distance between the proposed equipment and the nearby property boundaries, the sound levels associated with the Project's mechanical equipment are expected to comply with CT DEEP's noise standards and have no adverse noise impacts at nearby sensitive receptor locations. Noise mitigation is not necessary for the Project.

Construction Activities

Construction activities, including the intermittent use of heavy machinery, may result in temporary increases in nearby sound levels at the proposed Project. The Project is expected to generate typical sound levels from construction activities, including truck movements, heavy equipment operations, and general construction activities. Heavy machinery, such as front-end loaders, graders, bull dozers, and backhoes, would be used intermittently throughout the proposed Project's construction.

Section 22a-69-1.8(g) of the CT DEEP's noise control regulation states that noise associated with construction activities are exempt from the regulation. Construction activities such as site excavation/grading and installation of the solar panel systems would typically be limited to normal daytime working hours. While construction noise is exempt from the regulation, construction activities beyond normal daytime work hours would be minimized to the extent practicable.

ATTACHMENT A

100/125 kW, 1500 Vdc String Inverters for North America

CPS SCH100/125KTL-DO/US-600

The 100 and 125 kW high power CPS three-phase string inverters are designed for ground mount applications. The units are high performance, advanced, and reliable inverters designed specifically for the North American environment and grid. High efficiency at 99.1% peak and 98.5% CEC, wide operating voltages, broad temperature ranges, and a NEMA Type 4X enclosure enable this inverter platform to operate at high performance across many applications. The CPS 100/125 kW products ship with the Distributed or Centralized Wire Box, each fully integrated and separable with AC and DC disconnect switches. Enhanced DC Wire Boxes are available to allow DC disconnection under short circuit conditions. The CPS FlexOM Gateway enables communication, controls, and remote product upgrades.

Key Features

- NFPA 70 and NEC compliant
- Touch-safe DC Fuse holders add convenience and safety
- CPS FlexOM Gateway enables remote firmware upgrades
- Integrated AC and DC disconnect switches
- 1 MPPT with 20 fused inputs for maximum flexibility
- Copper- and aluminum-compatible AC connections
- NEMA Type 4X outdoor rated enclosure
- Advanced Smart-Grid features (CA Rule 21 certified)
- kVA headroom yields 100 kW @ 0.9 PF and 125 kW @ 0.95 PF
- Generous 1.87 (100 kW) and 1.5 (125 kW) DC/AC inverter load ratios
- Separable wire box design for fast service
- Enhanced DC wire boxes available

Standard Wire Boxes

Enhanced DC Wire Boxes

Chint Power Systems America
1380 Presidential Drive, Suite 100, Richardson, TX 75081
Tel: 855-584-7168 Mail: AmericaSales@chintpower.com Web: www.chintpowersystems.com

Model Name	CPS SCH100KTL-DO/US-600	CPS SCH125KTL-DO/US-600
DC Input		
Max. PV power	187.5 kW	
Max. DC input voltage	1500 V	
Operating DC input voltage range	860-1450 Vdc	
Start-up DC input voltage / power	900 V / 250 W	
Number of MPP trackers	1	
MPPT voltage range[1]	870-1300 Vdc	
Max. PV input current (Isc ×1.25)	275 A	
Number of DC inputs	Distributed Wire Box: 20 PV source circuits, positive and negative fused Centralized Wire Box: 1 input circuit, 1-2 terminations per pole, non-fused	
DC disconnection type	Load-rated DC switch	
DC surge protection	Type II MOV (with indicator/remote signaling)	
AC Output		
Rated AC output power[2]	100 kW	125 kW
Max. AC apparent power (selectable)	100 kVA (111 kVA @ PF > 0.9)	125 kVA (132 kVA @ PF > 0.95)
Rated output voltage	600 Vac	
Output voltage range[3]	528-660 Vac	
Grid connection type[4]	3Φ / PE / N (neutral optional)	
Max. AC output current @ 600 Vac	96.2 / 106.8 A	120.3 / 127.0 A
Rated output frequency	60 Hz	
Output frequency range[3]	57-63 Hz	
Power factor	>0.99 (±0.8 adjustable)	
Current THD	< 3%	
Max. fault current contribution (1 cycle RMS)	41.47 A	
Max. OCPD rating	200 A	
AC disconnection type	Load-rated AC switch	
AC surge protection	Type II MOV (with indicator/remote signaling)	
System		
Topology	Transformerless	
Max. efficiency	99.1%	
CEC efficiency	98.5%	
Standby / night consumption	< 4 W	
Environment		
Enclosure protection degree	NEMA Type 4X	
Cooling method	Variable speed cooling fans	
Operating temperature range[2]	-22°F to 140°F / -30°C to 60°C	
Non-operating temperature range[5]	-40°F to 158°F / -40°C to 70°C	
Operating humidity	0-100%	
Operating altitude	8202 ft / 2500 m (no derating)	
Audible noise	< 65 dBA @ 1 m and 77°F (25°C)	
Display and Communication		
User interface and display	LED indicators, Wi-Fi and app	
Inverter monitoring	Modbus RS485	
Site-level monitoring	CPS FlexOM Gateway (1 per 32 inverters)	
Modbus data mapping	SunSpec / CPS	
Remote diagnostics / firmware upgrade functions	Standard / (with FlexOM Gateway)	
Mechanical		
Dimensions (W × H × D)	Distributed Wire Box: 45.28 × 24.25 × 9.84 in (1150 × 616 × 250 mm) Centralized Wire Box: 39.37 × 24.25 × 9.84 in (1000 × 616 × 250 mm)	
Weight	Inverter: 121 lbs (55 kg) Distributed Wire Box: 55 lbs (25 kg) Centralized Wire Box: 33 lbs (15 kg)	
Mounting / installation angle	15-90 degrees from horizontal (vertical or angled)	
AC termination	M10 stud type terminal [3Φ] (wire range: 1/0 AWG-500 kcmil CU/AL; lugs not supplied) Screw clamp terminal block [N] (#12-1/0 AWG CU/AL)	
DC termination	Distributed Wire Box: Screw clamp fuse holder (wire range: #12-#6 AWG CU) Centralized Wire Box: Busbar, M10 bolts (wire range: #1 AWG-500 kcmil CU/AL [1 termination per pole], #1 AWG-300 kcmil CU/AL [2 terminations per pole]; lugs not supplied)	
Fused string inputs	Standard/Distributed Wire Boxes: 25 A fuses provided (fuse values up to 30 A acceptable) Enhanced DC Wire Boxes: 20 A fuses provided (fuse values up to 30 A acceptable)	
Safety		
Certifications and standards	UL 1741-SA/SB Ed. 3, CSA-C22.2 NO.107.1-01, IEEE 1547-2018, FCC PART15	
Selectable grid standard	IEEE 1547a-2014, IEEE 1547-2018[6], CA Rule 21, ISO-NE	
Smart-grid features	Volt-RideThru, Freq-RideThru, Ramp-Rate, Specified-PF, Volt-VAR, Freq-Watt, Vol-Watt	
Warranty		
Standard	5 years	
Extended terms	10, 15, and 20 years	

1) See user manual for further information regarding MPPT voltage range when operating at non-unity PF.
2) 100 kW active power derating begins at 113°F (45°C) when MPPT ≥ Vmin; 125 kW active power derating begins at 107.6°F (42°C) when PF = ±0.95 and MPPT ≥ Vmin, and at 113°F (45°C) when PF=1 and MPPT ≥ Vmin.
3) The "output voltage range" and "output frequency range" may differ according to the specific grid standard.
4) Delta configurations must not be corner-grounded.
5) See user manual for further requirements regarding non-operating conditions.
6) Firmware version 12.0 or later required.