BAC
Brooks Acoustics Corporation
35 Talcottville Road Suite 31 Vernon, CT 06066 (860) 896-1081

Mr. Bradley J. Parsons, PE, PMP
Director of Design and Permitting
Verogy
150 Trumbull Street, 4th Floor
Hartford, CT 06103

26 April 2023
PJ2023-1407-L01

Subject: East Windsor Solar Two – Solar power acoustical design study

Dear Mr. Parsons:

As requested, Brooks Acoustics Corporation (BAC) has conducted an acoustical engineering and design study to evaluate the sound emissions from the proposed Solar Two facility on Thrall Road in East Windsor, Connecticut, and any impact that those sound emissions may have on the surrounding neighborhood.

Importantly, the acoustical engineering evaluation has determined that the proposed facility as designed for this site will be ***in compliance*** with the requirements with the Regulations of Connecticut State Agencies (RCSA) Section 22a-69-1 et seq. ("Sound Regulations").

The acoustical engineering calculations are based on sound measurements of the proposed CPS Model electrical power inverter for the project, which were conducted on May 14, 2022 at the existing Solar One facility in East Windsor.

The estimated sound level from the solar power inverters operating at full load to the nearest residential property line to the SW is 9 dBA.

Based on these engineering calculations, it was determined that the Solar Two facility *is well below the allowable the CT State sound level limit (61 dBA) and is likely to be inaudible.* Therefore, the facility is expected to be compatible with Connecticut Siting Council requirements.

Sound Level Standards

The Regulations of Connecticut State Agencies (RCSA Section 22a – 69) require that noise emitted by an industrial land use to a residential land use shall not exceed 61 dBA (A-weighted decibels) during daytime hours, which are defined as 7:00 a.m. to 10:00 p.m. [see Sec. 22a-69-3.5. Noise zone standards (a)].

If the emitted sound possesses what is defined as an audible prominent discrete tone [see Sec. 22a-69-1.2. Acoustic terminology and definitions (r)], then the sound level which is otherwise not to be exceeded is reduced by 5 decibels [Sec. 22a-69-3.3. Prominent discrete tones]. The measured test data for the CPS inverter shows no indication of the presence of a prominent discrete tone. Please see the data graph shown below in this report. Therefore, *no tone penalty* may be applied.

So, the noise emitted by the proposed industrial land use to a residential land use shall not exceed 61 dBA during daytime hours. According to the CT Sound Regulations, the sound level which applies to the nearest residential receiver for this project would be taken at the nearest residential property line in the direction of that residence, which is generally to the southwest from the inverter equipment.

Sound Tests

Sound tests at the East Windsor Solar One facility on the south side of Middle Road, in East Windsor, Connecticut were conducted on 14 May 2022. These sound tests were conducted by Bennett Brooks of BAC. The facility was managed by Brad Parsons of Verogy during the tests. Field measurements of sound levels were performed in accordance with the requirements of accepted standard methods of environmental and equipment sound measurements.

The primary sound generating sources at the existing Solar One facility, and the proposed Solar Two facility are the DC to AC power inverters. These units convert the 12 volt DC power produced by the solar panels to the AC power used by the power transmission grid. The inverters can emit a humming sound. They also have cooling fans which run depending on the inverter temperature and can emit a whooshing sound.

The unit under test was a CPS Model power inverter. This model inverter as tested emits less sound (quieter) than other available power inverters. A product data sheet for this inverter is attached.

A view of the CPS Model Power inverter is shown below:

Tested Equipment – CPS Power Inverter – Sound measurement at 1 foot distance.

During the sound test the Solar One facility was operating at near full power capacity, as the sky was sunny, although somewhat hazy during that time. Therefore, the tested CPS power inverter was operating near full load capacity.

The primary field acoustic measurement system was a digital precision (Type 1) integrating logging sound level analyzer (NTi XL2). This acoustic measurement system was calibrated by a third-party laboratory with equipment directly traceable to the U.S. National Institute for Standards and Technology (NIST). The instrument was also field calibrated both before and after each test. The nominal accuracy for the measurement system is ±1.5 dB. During the sound test survey, observation logs and notes were written identifying the test procedures. Calibration certificates are available on request.

Data analysis

In this analysis, measured sound levels are given in terms of standard decibels, or "dB". These sound levels were A-weighted using standard digital filter networks.

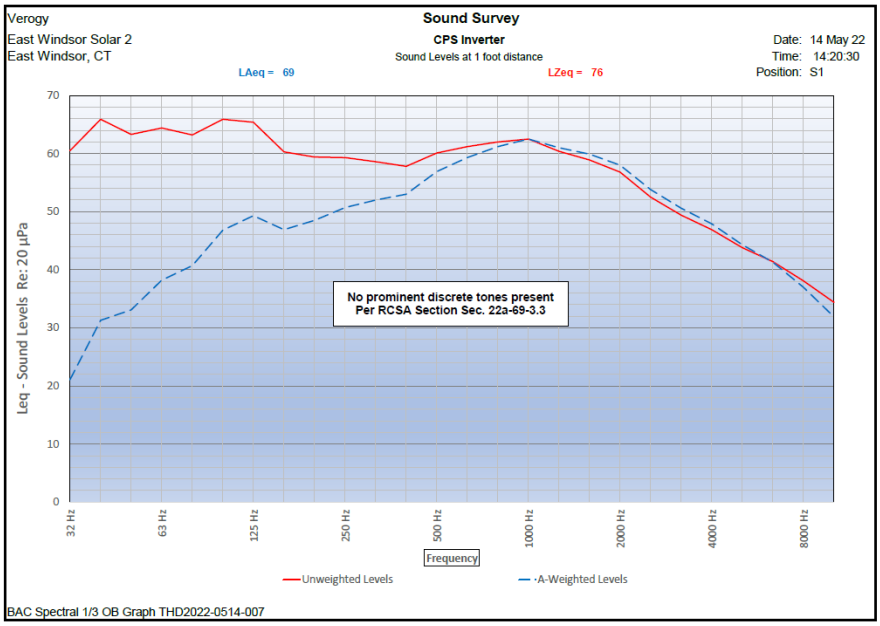
Sound level measurements which apply **A-weighting** are designated by the symbol **"dBA" or "dB(A)"**. The A-weighting filter mimics human hearing sensitivity and is used for assessing the impact of sound on people. The A-weighted levels are also designated in the sound level limits mandated by the CT Sound Regulations.

Spectral analysis – 1/3 Octave Bands

A spectral analysis of the measured sound record was done by which the test record is divided into bands, known as 1/3 octave bands (OB), which range from low frequency (bass) to high frequency (treble) sounds. The sound levels associated with each of these frequency bands may be shown on a **spectrum chart** ranging from low pitch on the left to high pitch on the right, like the arrangement of a piano keyboard. The measured 1/3 OB levels may be used in an engineering analysis of the sound. Also, they are used to determine the presence of a prominent discrete tone per CT Sound Regulations.

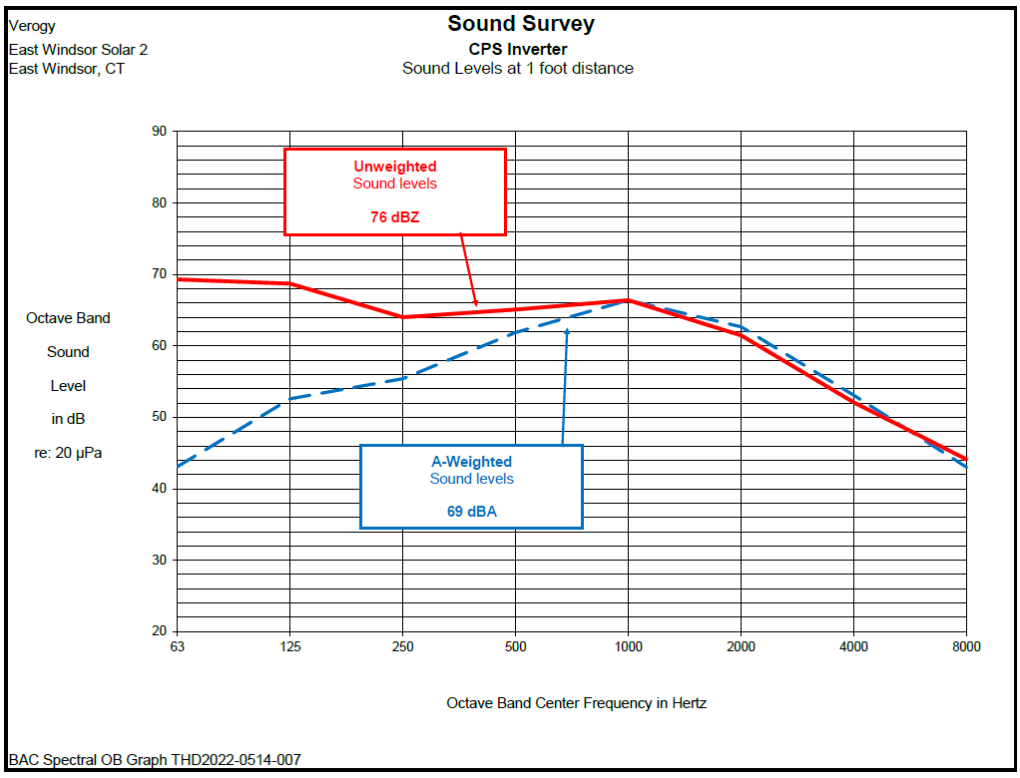
Sound Test Results

The measured sound level spectral metric was the energy average sound level (equivalent level) for the test period (LA_{eq}) measured in 1/3 Octave Bands.



In these data for the CPS Inverter, no prominent discrete tones were found per RCSA Sec. 22a-69-3.3.

The measured spectral data in 1/3 octave bands for the CPS Inverter were converted to octave band (OB) sound levels for the purposes of acoustical engineering calculations to estimate the sound levels for the proposed East Windsor Solar Two project. The CPS Inverter octave band chart is shown below:



Estimates of sound level at neighbor residences

Acoustical calculations were made to estimate the sound levels due to the operation of the solar power inverters at the nearest residence property line.

The source sound levels used for this analysis are based on measurements made by BAC at an existing solar power facility (East Windsor Solar One).

The inverters at the north side of the proposed facility were evaluated for potential impact on the neighborhood. The nearest residential receiver location was evaluated, which was the property line to the southwest in a direct line between the inverters and the residence.

The source sound for the proposed installation of **32 power inverters** at East Windsor Solar Two was characterized by taking the measured sound pressure level data for the CPS inverter unit and adjusting those data, using a sound power relationship, to the sound levels expected for 2 banks of 16 inverters each.

The source sound and location data were used as input to a computer modeling procedure which calculated the propagation of that sound through the atmosphere to the receptor position. The sound propagation calculation procedure accounts for the effects of the sources, distance, ground attenuation, vegetation, and atmospheric conditions, in accordance with the International Standard on the attenuation of sound during propagation outdoors, ISO 9613-2.

The site plan of the proposed facility is given in the All-Points drawing OP-2, dated April 2023, titled Partial Site Plan, and in the Verogy aerial photo and drawing CP-1, dated 2/24/2023, titled East Windsor Solar Two. The full drawings are attached for reference. The relevant portion of the aerial site plan is shown below.

The source sound data are shown on the calculation Source Sheets, attached. The path and receiver calculations sheets which indicate the calculation results are also attached.

The calculation results are summarized below:

Source/receiver condition	Distance	Sound level
32 CPS Inverters (full load)	1 foot	84 dBA
Nearest property line to SW	700 feet	9 dBA

Based on this study, the proposed facility and site layout is expected to provide a significant reduction in the sound levels from the inverter banks to the property line and the nearest neighbor residence to the SW. It is important to note that the sound level will *drop substantially* for houses located at greater distances.

Significantly, the projected sound levels at the neighbor residences are well below the prevailing background sound levels (30s to 40s dBA) in the area. Therefore, sound levels from the power inverters will be essentially *inaudible.*

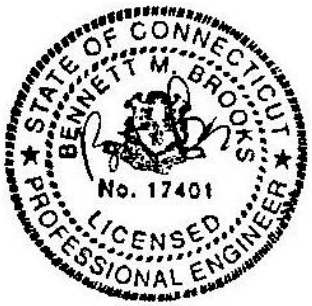
Further, the sound levels from the power inverters are expected be ***in full compliance*** with State of Connecticut Sound Regulations at all adjacent residences.

Please contact me if you have any questions concerning these findings.

Very truly yours,
BROOKS ACOUSTICS CORPORATION

Bennett M. Brooks, PE, FASA, INCE
President

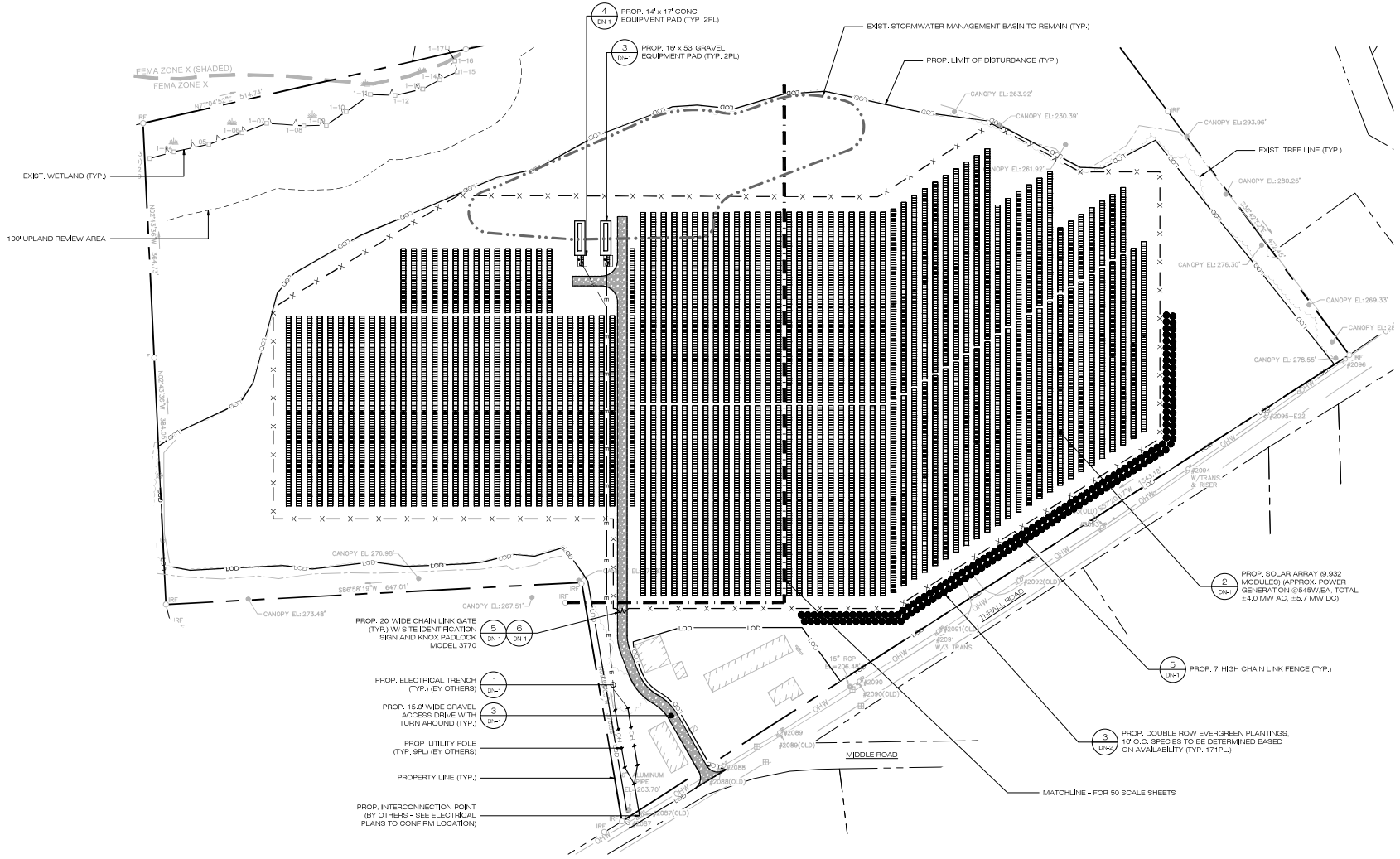
Attachments



APPENDIX

1- **Facility Data**
All-Points drawing OP-2, dated April 2023, titled Partial Site Plan
Verogy aerial photo and drawing CP-1, dated 2/24/2023, titled East Windsor Solar Two
CPS Inverter product data sheets

2- **Sound Projection Data**
Sound source sheets
Sound path and receiver sheets



1 OP-2 **PARTIAL SITE PLAN**
SCALE : 1" = 80'-0"

80 0 40 80 160
(IN FEET) 1 inch = 80 ft.

EAST WINDSOR
SOLAR TWO, LLC
150 TRUMBULL STREET
4TH FLOOR
HARTFORD, CT, 06103

ALL-POINTS TECHNOLOGY CORPORATION
567 VAUXHAUL STREET EXTENSION - SUITE 311
WATERFORD, CT 06385 PHONE: (860)-663-1697
WWW.ALLPOINTSTECH.COM FAX: (860)-663-0935

CSC PERMIT SET

NO	DATE	REVISION
0	04/XX/23	DRAFT SET FOR REVIEW: RCB
1		
2		
3		
4		
5		
6		

DESIGN PROFESSIONAL OF RECORD

PROF: ROBERT C. BURNS P.E.
COMP: ALL-POINTS TECHNOLOGY CORPORATION
ADD: 567 VAUXHAUL STREET EXTENSION - SUITE 311 WATERFORD, CT 06385

OWNER: CATHOLIC CEMETERIES ASSOCIATION OF THE ARCHDIOCESE OF HARTFORD, INC.
ADDRESS: 700 MIDDLETOWN AVE. NORTH HAVEN, CT 06473

EAST WINDSOR SOLAR TWO

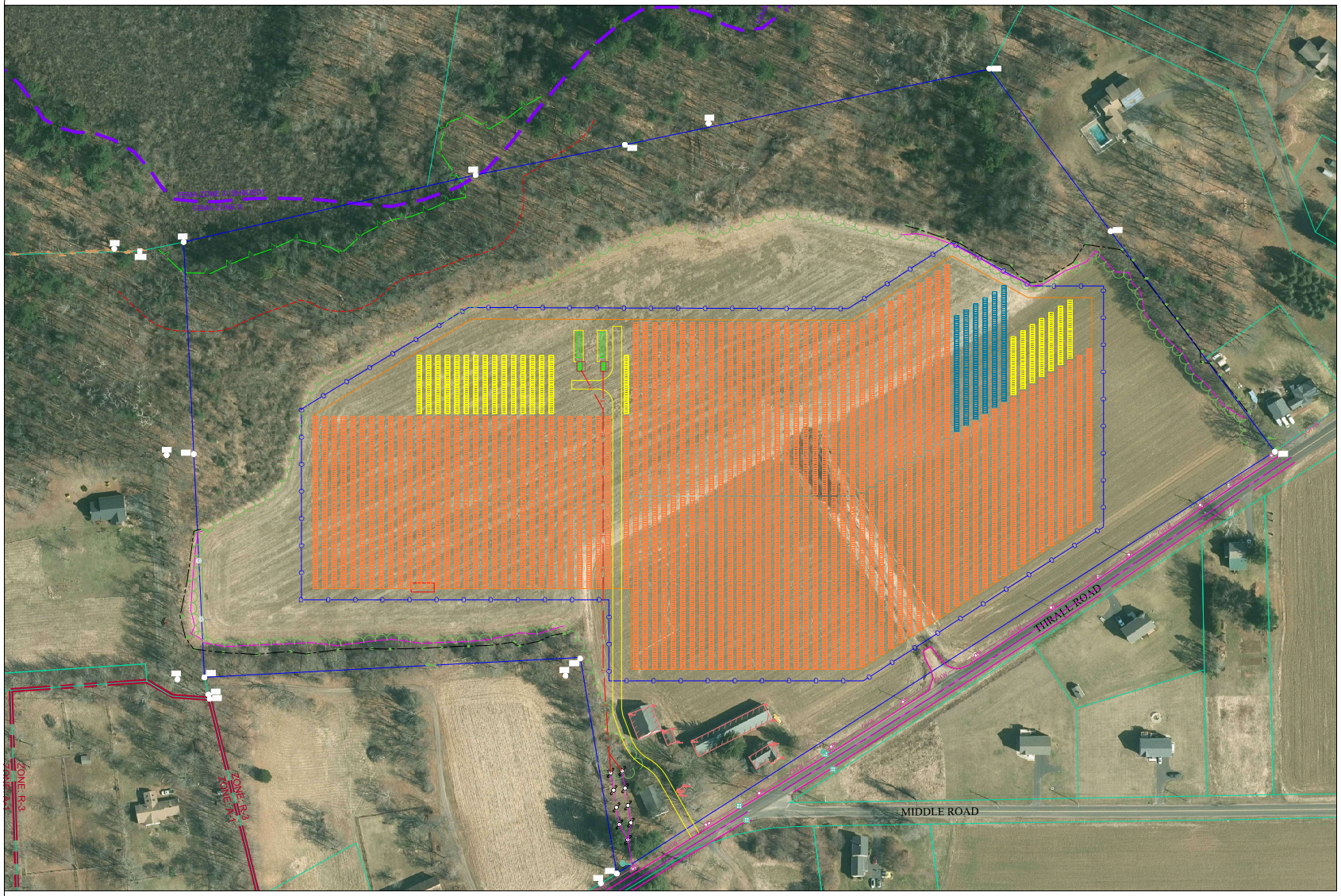
SITE ADDRESS: 31 THRALL ROAD, BROAD BROOK, CT 06016

APT FILING NUMBER: CT590340

DRAWN BY: CSH
DATE: 04/XX/23 CHECKED BY: RCB

SHEET TITLE:
PARTIAL SITE PLAN

SHEET NUMBER:
OP-2



CP-1

EAST WINDSOR SOLAR TWO

SCALE: 1" = 80'

General Notes

SYSTEM SPECIFICATIONS	
DC SYSTEM SIZE	5,412.94 kW
AC SYSTEM SIZE	4,000.0 kW
MODULE QUANTITY	9,932
MODULE POWER	545 W
TILT	Tracker
AZIMUTH	180°
NOTES	

No.	Revision/Issue	Date
1	ADDED LOD	9/10

Firm Name and Address

VEROGY

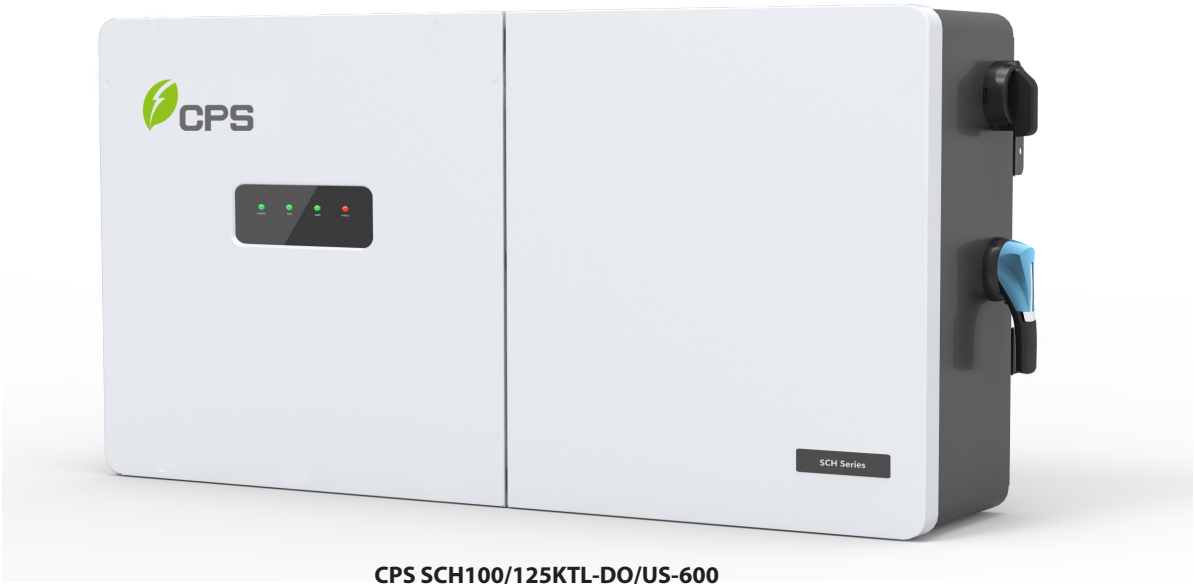
150 TRUMBULL STREET
HARTFORD, CT 06103

Project Name and Address

EAST WINDSOR SOLAR TWO
31 THRALL ROAD
EAST WINDSOR, CT 06016
41.893834, -72.531022

Project	Sheet
EW. SOLAR TWO	CP-1
Date: 02/24/23	
Drawn By: BJP	

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 Standard or Centralized Wire-box, each fully integrated and separable with AC and DC disconnect switches. The Standard Wire-box includes touch-safe fusing for up to 20 strings. 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
- Standard 5-year warranty with extensions to 20 years

100/125KTL Standard Wire-box

100/125KTL Centralized Wire-box

C SP US

This device complies with part 15 of the FCC Rules

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 x 1.25)	275 A	
Number of DC inputs	Standard Wire-box: 20 PV source circuits, pos. and neg. 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	100 kW	125 kW
Max. AC output power[2]	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)	>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%	
Stand-by / night consumption	<4 W	
Environment		
Enclosure protection degree	NEMA Type 4X	
Cooling method	Variable speed cooling fans	
Operating temperature range	-22°F to +140°F / -30°C to +60°C (derating from +108°F / +42°C)	
Non-operating temperature range[5]	-40°F to +158°F / -40°C to +70°C maximum	
Operating humidity	0-100%	
Operating altitude	8202 ft / 2500 m (no derating)	
Audible noise	<65 dBA @ 1 m and 25°C	
Display and Communication		
User interface and display	LED indicators, WiFi + 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 x H x D)	Standard Wire-box: 45.28 x 24.25 x 9.84 in (1150 x 616 x 250 mm) Centralized Wire-box: 39.37 x 24.25 x 9.84 in (1000 x 616 x 250 mm)	
Weight	Inverter: 121 lbs (55 kg) Standard 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	Standard Wire-box: Screw clamp fuse holder (wire range: #12 - #6 AWG CU) Centralized Wire-box: Busbar, M10 bolts (wire range: #1AWG - 500kcmil CU/AL [1 termination per pole], #1 AWG - 300 kcmil CU/AL [2 terminations per pole]; lugs not supplied)	
Fused string inputs	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, Volt-Watt	
Warranty		
Standard[7]	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) "Max AC apparent power" rating valid within MPPT voltage range and temperature range of -30°C to +40°C (-22°F to +104°F) for 100 kW PF≥0.9, and 125 kW PF≥0.95.
3) The "output voltage range" and "output frequency range" may differ according to the specific grid standard.
4) Wye neutral-grounded; delta may not be corner-grounded.
5) See user manual for further requirements regarding non-operating conditions.
6) Firmware version 12.0 or later required.
7) 5-year warranty effective for units purchased after October 1, 2019.

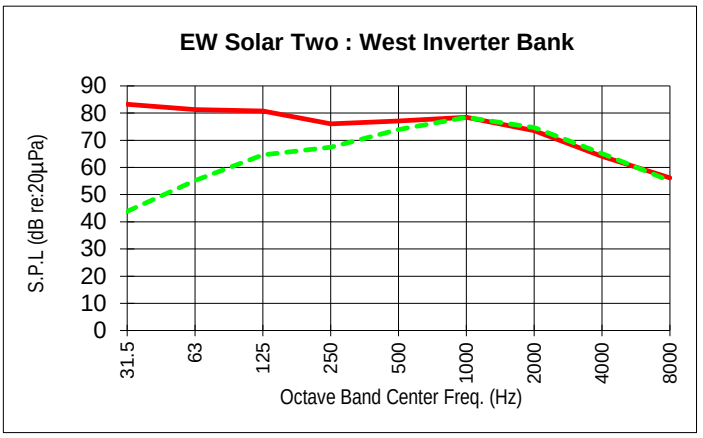
Source Sheet

Source Group: EW Solar Two
Source Name: West Inverter Bank

Source Data: BAC Un-weighted
Source Level: 81 dB(A)
record distance: 1

Source Type: point

Coordinates:	East	North	Elev.
	0	0	5

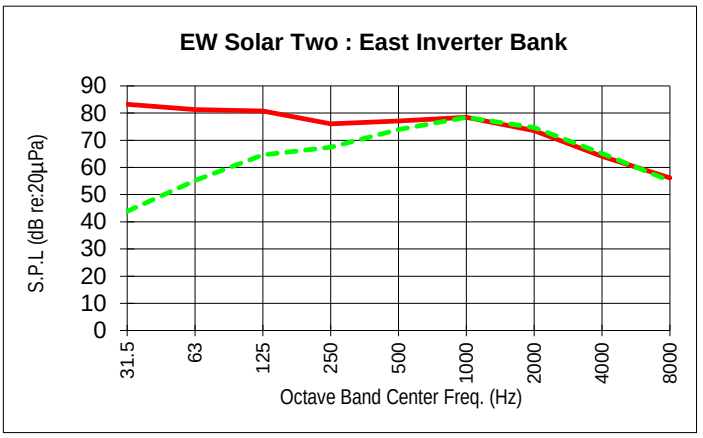


Frequency	Data		Signature	A-weighted Signature	A-weighting Curve	freq.
31.5 Hz	71.2		**83**	44	-39.4	31.5
63.0 Hz	69.3		**81**	55	-26.2	63
125.0 Hz	68.7		**81**	65	-16.1	125
250.0 Hz	64.0		**76**	67	-8.6	250
500.0 Hz	65.1		**77**	74	-3.2	500
1000.0 Hz	66.4		**78**	78	0.0	1000
2000.0 Hz	61.5		**74**	75	1.2	2000
4000.0 Hz	52.1		**64**	65	1.0	4000
8000.0 Hz	44.1		**56**	55	-1.1	8000

BAC data Un-weighted for CPS Inverter

Data adjusted for 16 Inverters

Source Sheet



Source Group: EW Solar Two
Source Name: East Inverter Bank

Source Data: BAC Un-weighted
Source Level: 81 dB(A)
record distance: 1

Source Type: point

Coordinates:	East	North	Elev.
	40	0	5

Frequency	Data		Signature	A-weighted Signature	A-weighting Curve	freq.
31.5 Hz	71.2		**83**	44	-39.4	31.5
63.0 Hz	69.3		**81**	55	-26.2	63
125.0 Hz	68.7		**81**	65	-16.1	125
250.0 Hz	64.0		**76**	67	-8.6	250
500.0 Hz	65.1		**77**	74	-3.2	500
1000.0 Hz	66.4		**78**	78	0.0	1000
2000.0 Hz	61.5		**74**	75	1.2	2000
4000.0 Hz	52.1		**64**	65	1.0	4000
8000.0 Hz	44.1		**56**	55	-1.1	8000

BAC data Un-weighted for CPS Inverter

Data adjusted for 16 Inverters

Verogy - East Windsor Solar Two

Based on BAC sound data and proposed site plan

Property Line Sound Study

Proposed site layout with sound control

Sound Projection: Proposed Solar Power Facility

PROJECTED FROM: Power Inverters
PROJECTED TO: Nearest residential property line to SW

Coordinates: East	North	Elevation
-658.0	-249.0	5.0

RELATIVE HUMIDITY: 50%
TEMPERATURE: 72 deg. F
ATMOS. PRESS: 760 mm Hg

Criteria Level 61 dBA
Total Sound Level **9 dBA**

Compliance?
YES

FREQ.	AWT SPL
31.5 Hz	-22.1
63 Hz	-10.8
125 Hz	-13.3
250 Hz	-14.9
500 Hz	-4.5
1000 Hz	7.3
2000 Hz	3.2
4000 Hz	-11.3
8000 Hz	-38.5
RMS:	9.1

#	SOURCE	CONTRIBUTIONS AWT SPL
1	EW Solar Two West Inverter Bank	6.3 dBA
2	EW Solar Two East Inverter Bank	5.8 dBA
3	reserved --	-55.5 dBA
4	reserved --	-55.5 dBA
5	reserved --	-55.5 dBA
6	reserved --	-55.5 dBA
7	reserved --	-55.5 dBA
8	reserved --	-55.5 dBA
9	reserved --	-55.5 dBA
10	reserved --	-55.5 dBA
11	reserved --	-55.5 dBA
12	reserved --	-55.5 dBA

Atmospheric attenuation:	yes
Excess gound attenuation:	yes
Source region hard, soft, mixed (h,s,m%):	s
Receiver region hard, soft, mixed (h,s,m%):	s
Middle region hard, soft, mixed (h,s,m%):	s
Barrier shadowing:	no
Vegetation	yes

PATH SHEET

		COORDINATES		Record Distance
SOURCE 1:	EW Solar Two	East	0.0	
	West Inverter Bank	North	0.0	1.0
TYPE:	point	Elevation	5.0	Projection Dist.
				703.5

Freq.	Source	Vegetation	Shadowing	Ground Atten	Net Barrier Atten	Atmospheric	Distance Atten	Contribution	Awt Contrib.
31.5 Hz	71.2	1.0	0.0	-1.3	-1.3	0.0	56.9	14.5	-24.9
63 Hz	69.3	1.0	0.0	-1.3	-1.3	0.0	56.9	12.6	-13.6
125 Hz	68.7	1.6	0.0	10.1	10.1	0.1	56.9	0.0	-16.1
250 Hz	64.0	2.1	0.0	13.8	13.8	0.3	56.9	-9.1	-17.7
500 Hz	65.1	2.1	0.0	9.5	9.5	0.6	56.9	-4.1	-7.3
1000 Hz	66.4	2.6	0.0	1.2	1.2	1.1	56.9	4.5	4.5
2000 Hz	61.5	3.1	0.0	0.0	0.0	2.1	56.9	-0.7	0.5
4000 Hz	52.1	4.2	0.0	0.0	0.0	5.9	56.9	-14.9	-13.9
8000 Hz	44.1	6.2	0.0	0.0	0.0	20.6	56.9	-39.7	-40.8
								17.1	6.3

PATH SHEET

		COORDINATES		Record Distance
SOURCE 2:	EW Solar Two	East	40.0	
	East Inverter Bank	North	0.0	1.0
TYPE:	point	Elevation	5.0	Projection Dist.
				741.1

Freq.	Source	Vegetation	Shadowing	Ground Atten	Net Barrier Atten	Atmospheric	Distance Atten	Contribution	Awt Contrib.
31.5 Hz	71.2	1.0	0.0	-1.3	-1.3	0.0	57.4	14.0	-25.4
63 Hz	69.3	1.0	0.0	-1.3	-1.3	0.0	57.4	12.1	-14.1
125 Hz	68.7	1.6	0.0	10.1	10.1	0.1	57.4	-0.5	-16.6
250 Hz	64.0	2.1	0.0	13.8	13.8	0.3	57.4	-9.5	-18.1
500 Hz	65.1	2.1	0.0	9.5	9.5	0.7	57.4	-4.6	-7.8
1000 Hz	66.4	2.6	0.0	1.2	1.2	1.1	57.4	4.0	4.0
2000 Hz	61.5	3.1	0.0	0.0	0.0	2.2	57.4	-1.3	-0.1
4000 Hz	52.1	4.2	0.0	0.0	0.0	6.2	57.4	-15.7	-14.7
8000 Hz	44.1	6.2	0.0	0.0	0.0	21.7	57.4	-41.2	-42.3
								16.6	5.8

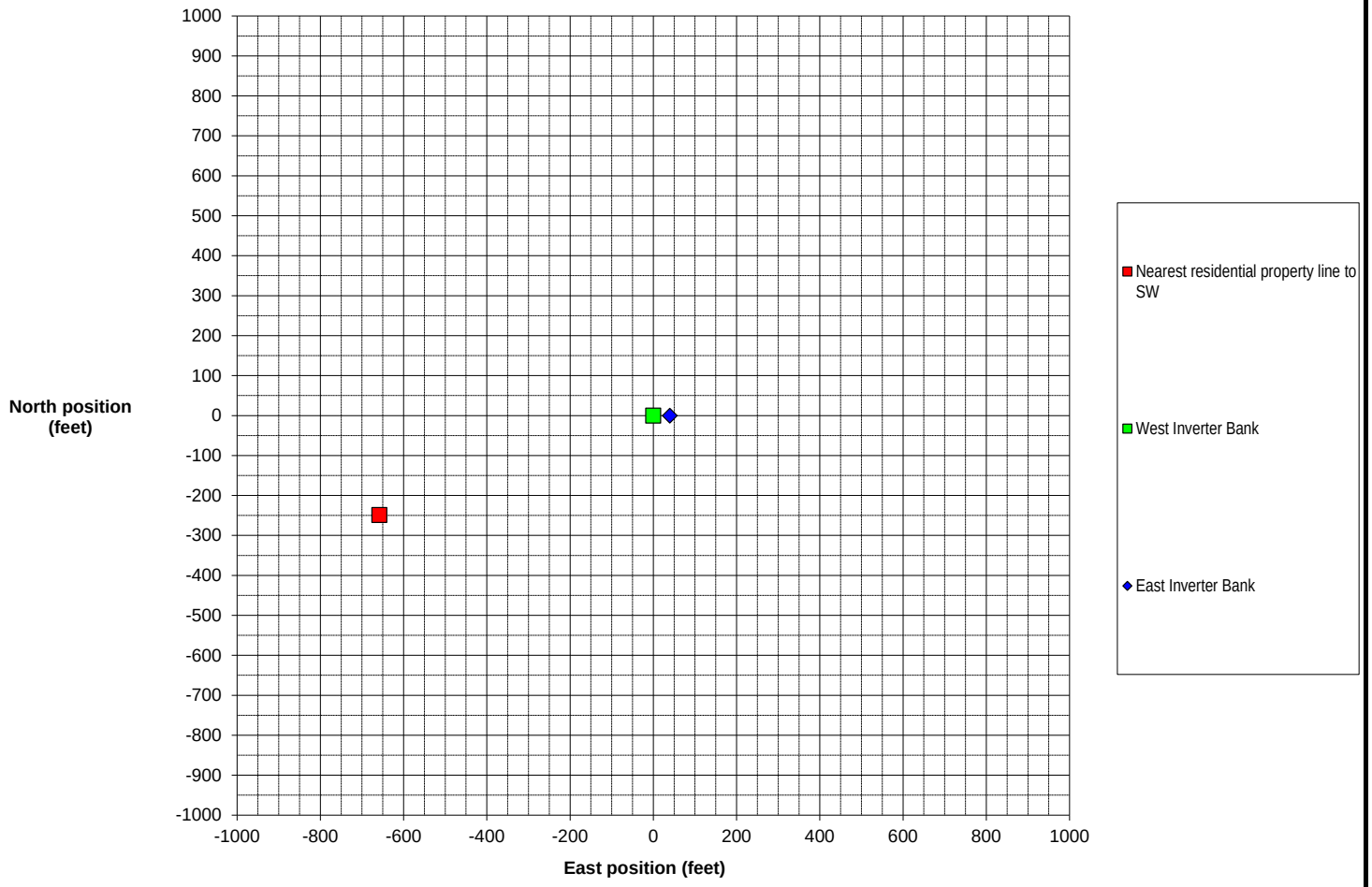
Verogy - East Windsor Solar Two
Property Line Sound Study
Proposed Solar Power Facility

Sound Source - Receiver Location Plot

Sound Source Contribution Plot

Nearest residential property line to SW

RMS: 9.1 dBA



BAC Sound Projection Graph Design Calculation 1

Verogy - East Windsor Solar Two

Property Line Sound Study

Proposed Solar Power Facility

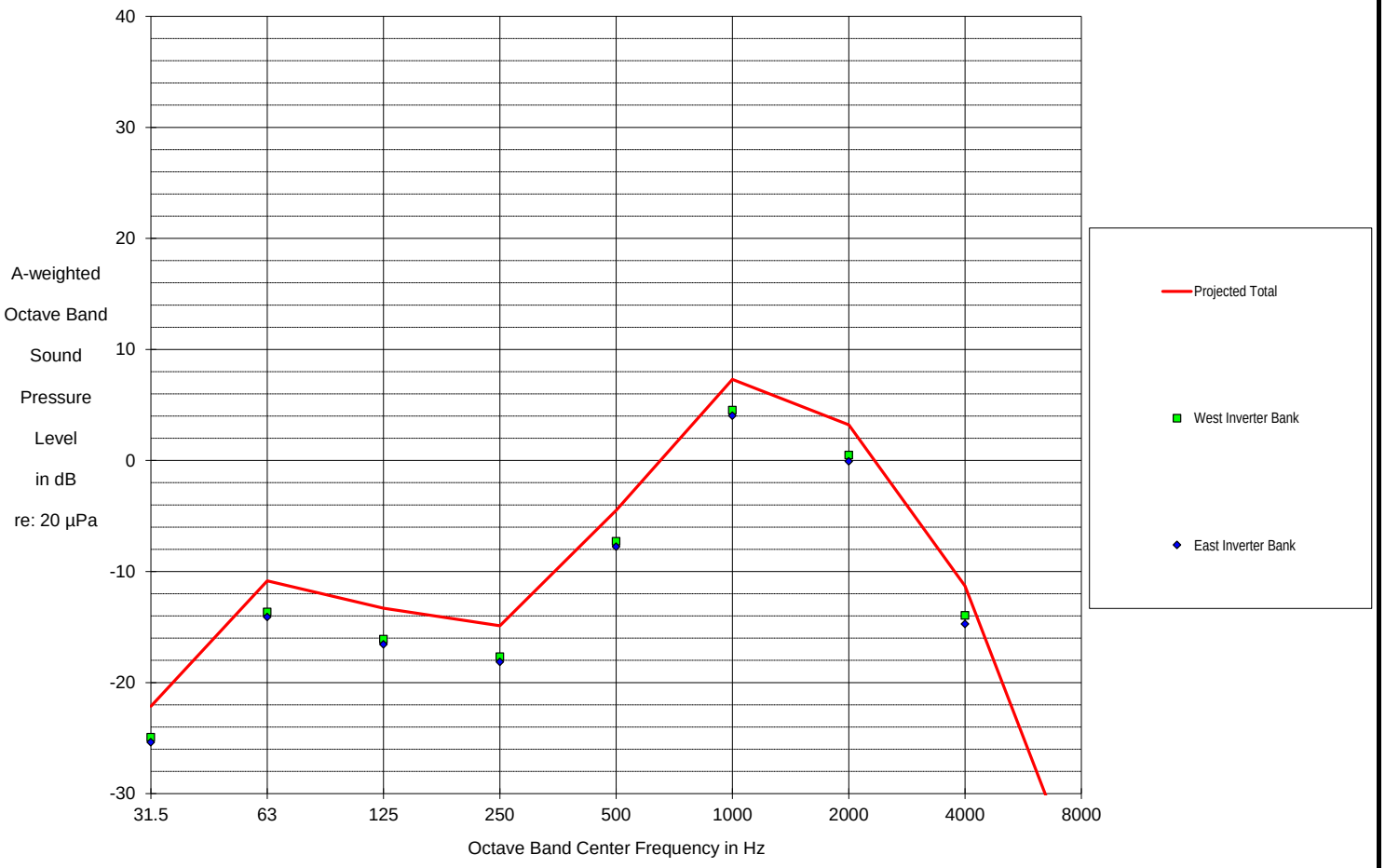
Sound Source Contribution Plot

Nearest residential property line to SW

Based on BAC sound data and proposed site plan

Proposed site layout with sound control

RMS: 9 dBA



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