Sound Power Outputs for Sunny Central Inverters

Proposed Solar Energy Facility

331 Sydney Road, Benalla

Prepared for:

Southern Sustainable Electric (Aust.) Pty Ltd

Southern Sustainable Electric

Rev. 1; February 2020

Based on:

- White Paper BU-U-019: Sunny Central and Sunny Central Storage Sound Power Measurements on SC/SCSxxxx (-EV) (-US) central inverters
- Noise From Industry in Regional Victoria, EPA Publication 1411, October 2011
- https://www.noisehelp.com/
- https://www.industrialnoisecontrol.com/
- Planning Report 4.95MW Solar Energy Facility, 331 Sydney Road, Benalla; Chris Smith & Assoc.

Introduction

This report reviews the design of a proposed solar energy facility at 331 Sydney Road, Benalla, for Southern Sustainable Electric (Australia) Pty Ltd with regard to potential amenity impacts due to noise emitted to houses (sensitive noise receivers) surrounding land. This report has been amended to address specific points raised by DELWP officers, when assessing the proposal.

The site for the proposed facility has been selected as a result of a rigorous assessment and selection process that included consideration of locational context and established amenity. The chosen site for the proposed facility has previously been used for agriculture, but is within an area that includes a number of large-format industries and has main road frontage, therefore has a somewhat altered amenity in comparison to "typical" rural areas in Victoria.

The proposed facility will be largely "static" – i.e. no moving parts; therefore, any noise generation from the facility – during operation, apart from any periodical maintenance activities – will be limited to the fans within the inverters.

This report is based on the product information by SMA / Sunny Central for sound power from their central inverters that were performed in accordance with the relevant ISO standard. The information gathered shows that the proposed facility will not create an unacceptable noise impact to houses on surrounding properties in the Farming Zone.

The Site

The site chosen for the proposed solar energy facility is a rectangular 13.34 hectare plot with frontage to Sydney Road, that is the main road connector between Benalla and the Hume Freeway for passenger vehicles as well as freight and commercial vehicles, including a considerable percentage of heavy vehicles.

The site is approximately 1.6km from the urban edge of Benalla, where long-established industrial and highway commercial businesses such as a sawmill, car wreckers, metal recycling and a concrete batching plant are located. To the north and northeast are the LS Precast concrete factory and D&R Henderson timber products factory, which both operate for extended hours under shift-work.

There are four houses on farm properties nearby the site. The proposed facility has been positioned to the rear of the site, to maximise distance to these houses. The nearest house is directly west; the properties adjoining to the east and north do not contain houses. The only structure on the property to the east is the remains of a small building that is inhabitable.

The Proposed Facility

It is proposed to develop the rear portion of the site for a solar energy facility as per the Layout Plan by Southern Sustainable Electric (see extract of Layout Plan below). The front of the land will be retained for continued grazing.

The solar facility consists of rows of solar panels that are fixed in position (no moving parts) and aligned in east – west arrays to maximise solar exposure and transfer of energy. The solar panels are divided into two blocks; each block is connected to a central inverter – SMA MPV2500. Energy collected and converted to electricity is distributed into the overhead electricity network at the front of the land via an E-Cube kiosk.

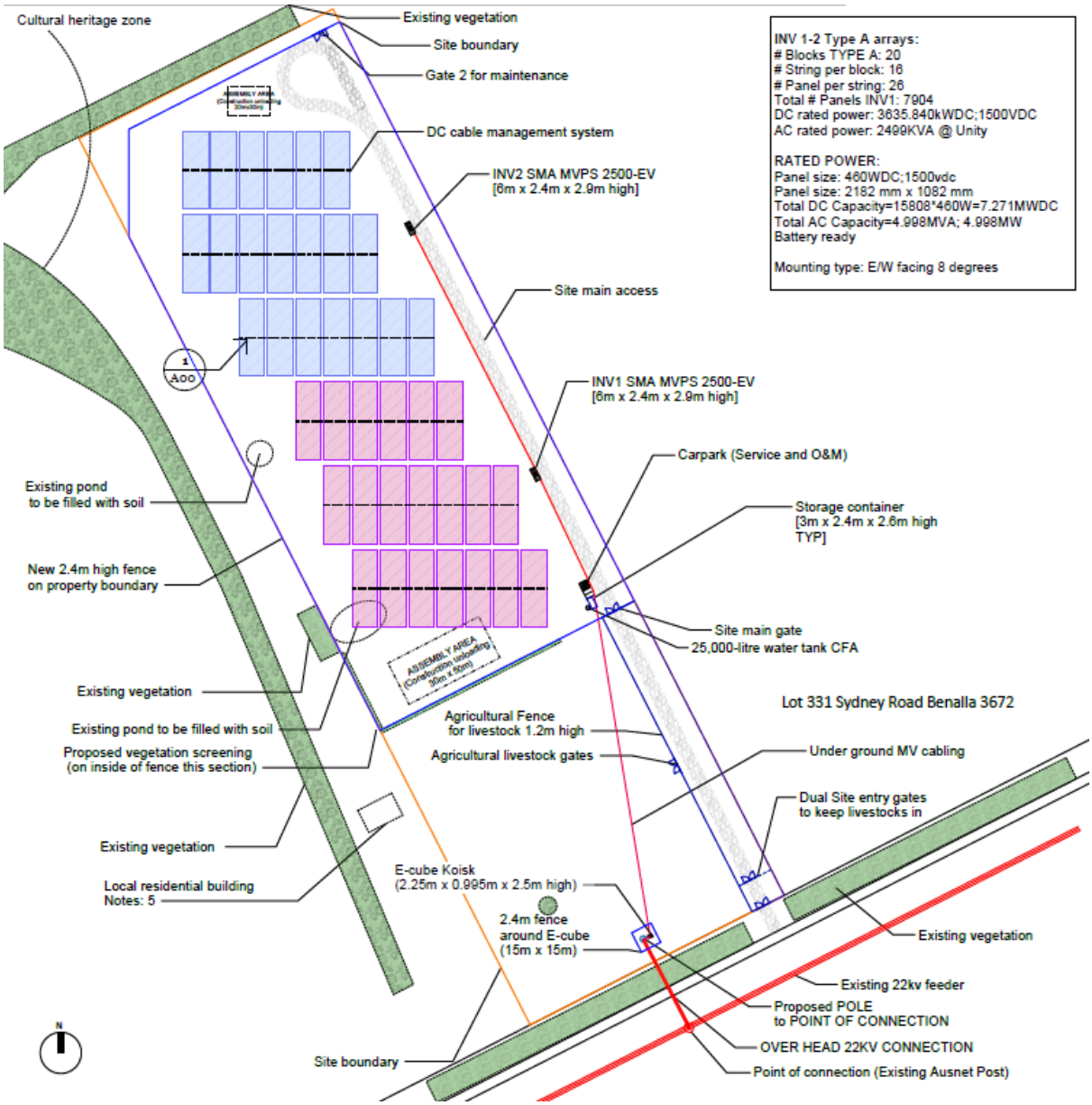

Figure 1: Proposed Layout of Solar Facility

Noise output Guidelines - NIRV

EPA publication 1411 – ***Noise from Industry in Regional Victoria*** (referred to herein as NIRV) provides recommendations for maximum noise levels to manage the impacts of noise on the community. It is a non-statutory guideline that can be used by regulators that issue statutory approvals. When applied through a statutory process such as a planning permit, the recommended levels become binding and enforceable through compliance. It is noted that the guidelines provide different degrees amenity protection in different land-use zones, with the highest level of protection being for residential areas for normal domestic use of the home and sleep at night.

Table 1 (within NIRV) sets out the levels for noise at the receiving location for each emitting zone and receiving zone. In this instance, both the emitting site and receiving site (all surrounding land) are within the Farming Zone, that has the following recommended levels:

Day: 46 Evening: 41 Night: 36

The above periods are defined as:

Day	0700–1800 Monday–Friday 0700–1300 Saturdays
Evening	1800–2200 all days 1300–1800 Saturdays 0700–1800 Sundays and public holidays
Night	2200–0700

The Zone Levels from Table 1 must only be applied in conjunction with steps 2 to 5 within the guidelines. These steps have been worked through, as follows:

Step 2 - Distance adjusted levels: where the noise generator and receiver are in the same contiguous zone, the distance adjustment is 0.

Step 3 – Base noise level check: Check the distance adjusted levels from Step 2 against the 'base noise levels.' For each period, adopt the greater of the distance-adjusted level and base noise level.
The distance-adjusted noise levels of Day: 46; Evening: 41; Night: 36 prevail

Step 4 - Background level check and adjustment: where a background level assessment has not been carried out – as is the case for this proposal – the Step 3 recommended level should be carried through. Background measurements should not be necessary for simple situations where noise from the emitter will meet Step 3 levels.

Step 5 - High traffic noise areas: Although it is considered that the site may be in a high noise area due to traffic from Sydney Road, this cannot be conclusively stated in the absence of background noise measurements.

Accordingly, the recommended maximum noise levels from Table 1 of NIRV should be adopted for each period of the day: Day: 46 Evening: 41 Night: 36

These maximum noise levels are to be achieved at any sensitive receiver.
Sensitive noise receivers in the vicinity of the proposed facility are:

- **Resident 1 - 321 Sydney Rd (~250m from nearest inverter)**
- **Resident 2 - 350 Sydney Rd (~560m from nearest inverter)**
- **Resident 3 - 390 Sydney Rd (~650m from nearest inverter)**
- **Resident 4 - 402 Sydney Rd (~810m from nearest inverter)**
  As shown on Figure 2 (below)

Notwithstanding the recommended maximum noise level, it is noted:

- The recommended zone levels (Table 1) for the Farming Zoning are based on the assumption that the vast majority of rural areas (defined by the Farming Zone) are typically quiet, where industrial noise can be intrusive and, therefore, be audible over distance and disturb the rural environment.
- The subject site's locational context – being abutted by a major road and nearby large-format industry that operate extended shifts.

Accordingly, it is considered that the most stringent application of NIRV has been applied.

Figure 2: Nearby residences (distances to property boundary of proposed site)

Sound Power Output

The facility designers advise that the only considerable operational noise generators in the facility (other than periodical maintenance) are the MPV inverters, that have multi-stage fans to cool their internal componentry during operation.

The fans do not operate constantly, but start up automatically, when a pre-set internal temperature is breached. Fan speed is automatically governed by the amount of cooling required. Maximum fan power would only be triggered when the inverter is working at maximum capacity in times of high ambient temperature.

White Paper BU-U-019 provides the results of sound power measurements for one inverter under normal operating conditions, with all inverter fans operating at maximum speed. The measurements were performed in accordance with the relevant ISO standard.

The SMA S2500 MPV inverter that is to be used at the proposed facility was measured to have a sound power output of 92dB(A). This sound dissipates over distance, as shown in Table A and the graph in Figure 2 (both over page) to 44dB(A) under "free field conditions over a reflective plain."[1] This level of noise is comparable to a domestic refrigerator (see noise chart at Appendix A.

NIRV does not apply to construction activities. The construction phase of the project is not within the scope of this report. Measures such as a construction management plan can be implemented by permit conditions to set out allowable construction hours and activities.

Distance	SC 1850-US, SCS 1900 SC/SCS 2200 & SC/SCS 2200-US SC/SCS 2475 & SC/SCS 2475-US SCS 2900 & SCS 2900-US	SC/SCS 2500-EV & SC/SCS 2500-EV-US SC/SCS 2750-EV & SC/SCS 2750-EV-US SC/SCS 3000-EV
1 m	79	77
10 m	66	64
20 m	60	58
30 m	56	55
40 m	54	52
50 m	52	50
60 m	50	49
70 m	49	47
80 m	48	46
90 m	47	45
100 m	46	44

Table A: Sound power levels over distance (Source: White Paper BU-U-19; SMA)

[1] SMA White Paper BU-U-019

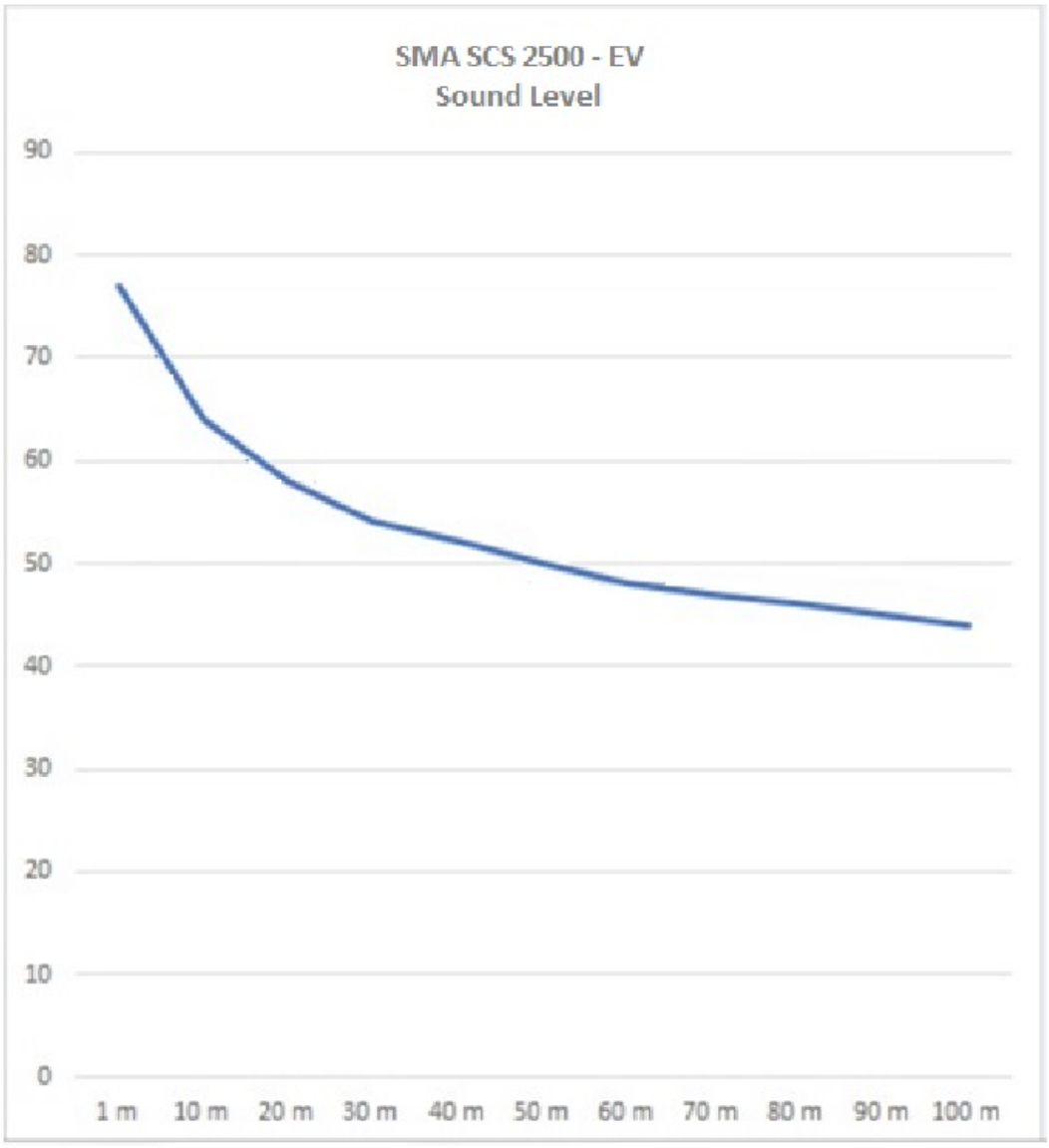

Figure 2: Graph of sound power levels over distance

The inverters operate when electricity is conveyed to them from the PV solar panels. Thus, will only operate in daylight hours. The facility designers state that – during the height of summer when daylight hours are at a maximum, it is possible that solar energy production could begin at 6:30am and continue until 8pm. Accordingly, the worst case scenario that is possible – although not perennially or constantly - is the inverters could be operating within the 'night' period – i.e. after 6pm on Saturdays and Sundays as well as before 7am; albeit for only relatively small parts of these periods and it is unlikely that they will be running at full power.

The nearby potentially affected sensitive receivers of noise are the houses on surrounding land, with the house on the adjacent land (to the west) at 321 Sydney Road being the nearest. The facility has been designed to place the inverters as far as practically possible from this house. Accordingly, it is more than 250m away from the nearest inverter, as shown on figures 3 and 4 below.

Extrapolation of Table A for dissipation of noise in a free field over a reflective plain, to a distance of 250m* provides a noise level of 29dB(A), which is less than zone levels from Table 1 of NIRV for Day, Evening and Night periods.

Recommended maximum noise levels:	**Day: 46**	**Evening: 41**	**Night: 36**
Extrapolated maximum noise level at 250m* separation:	**Day: 29**	**Evening: 29**	**Night: 29**

*Separation distance to nearest sensitive receiver

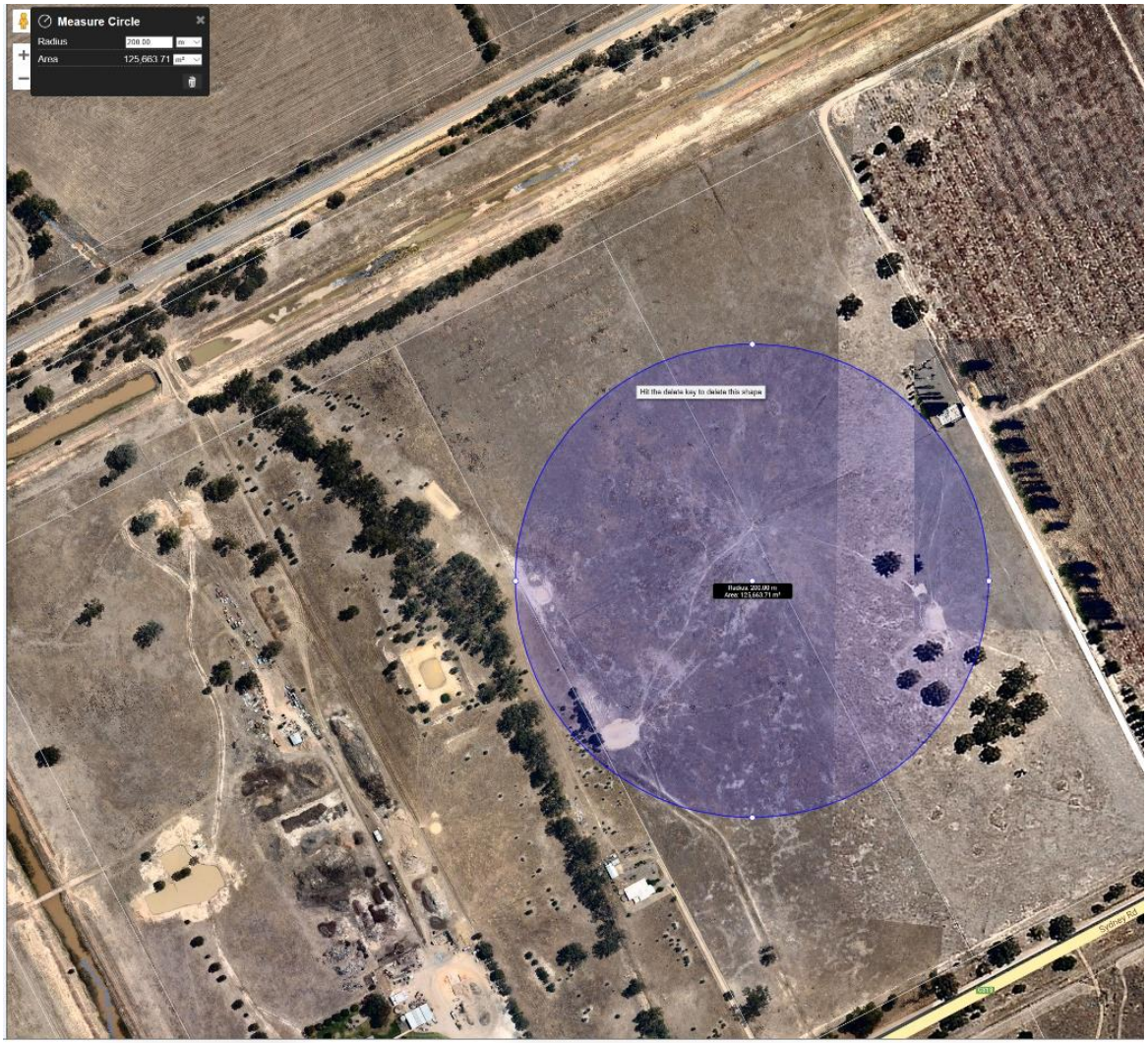

Figure 3: 200m radius from proposed location of inverter 1.

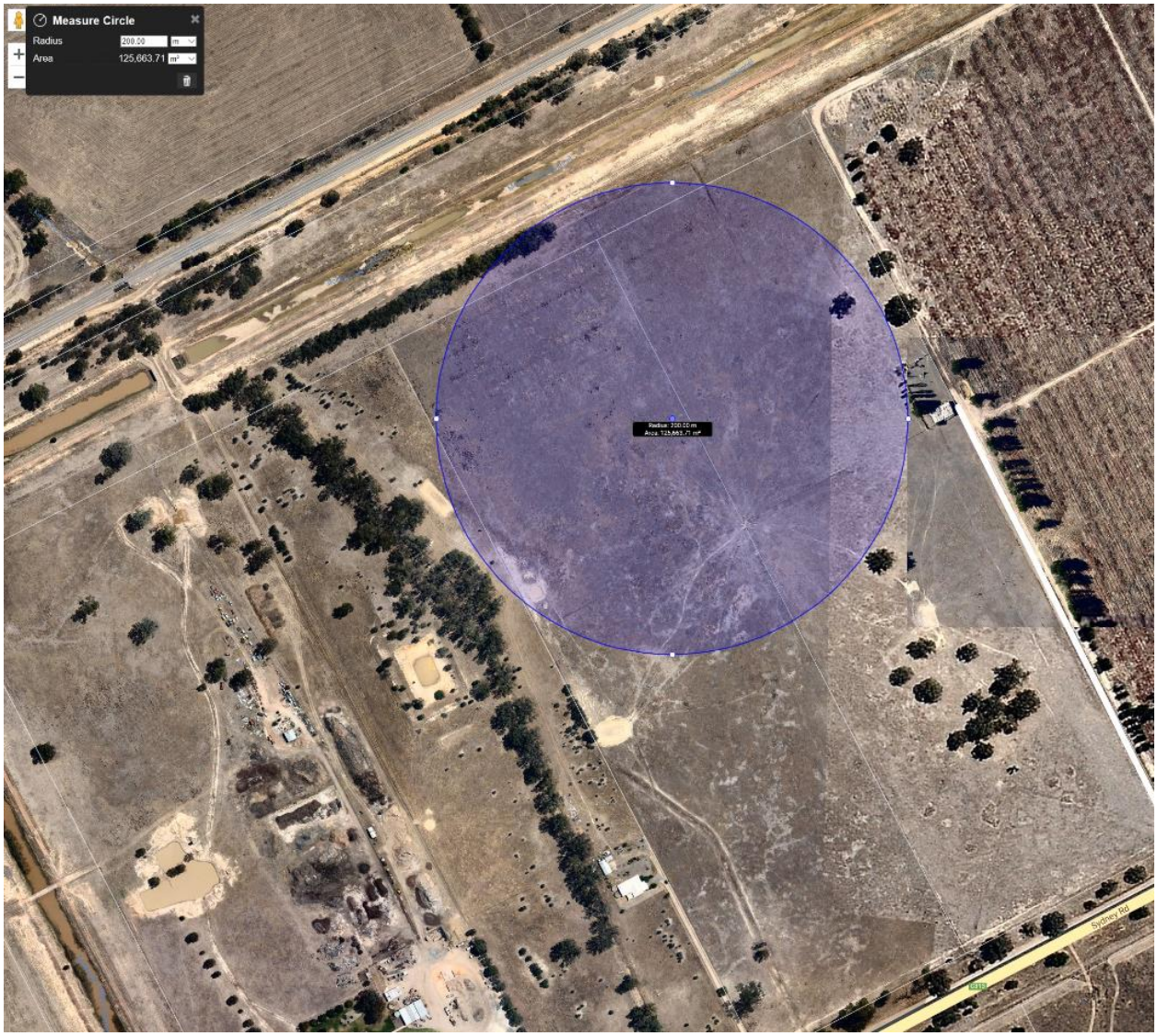

Figure 4: 200m radius from proposed location of inverter 2.

Conclusion

The sound power outputs over distance by SMA illustrate that potential noise from the inverter dissipates to 44dB over a distance of 100m. Extrapolation of Table A to a distance of 250m provides a noise level of 29dB(A), which is less than a whisper[2].

The nearest potential sensitive receiver is located more than 250m from the nearest inverter. Extrapolation of the information provided by SMA indicates that noise from the proposed facility will be less than the recommended zone levels from Table 1 of NIRV for Day, Evening and Night periods.

Recommended maximum noise levels:	**Day: 46**	**Evening: 41**	**Night: 36**
Extrapolated maximum noise level at 250m* separation:	**Day: 29**	**Evening: 29**	**Night: 29**

*Separation distance to nearest sensitive receiver

[2] www.noisehelp.com (see Appendix A)

Appendix A

dBA	Example	Home & Yard Appliances	Workshop & Construction
0	healthy hearing threshold		
10	a pin dropping		
20	rustling leaves		
30	whisper		
40	babbling brook	computer	
50	light traffic	refrigerator	
60	conversational speech	air conditioner	
70	shower	dishwasher	
75	toilet flushing	vacuum cleaner	
80	alarm clock	garbage disposal	
85	passing diesel truck	snow blower	
90	squeeze toy	lawn mower	arc welder
95	inside subway car	food processor	belt sander
100	motorcycle (riding)		handheld drill
105	sporting event		table saw
110	rock band		jackhammer
115	emergency vehicle siren		riveter
120	thunderclap		oxygen torch
125	balloon popping		
130	peak stadium crowd noise		
135	air raid siren		
140	jet engine at takeoff		
145	firecracker		
150	fighter jet launch		
155	cap gun		
160	shotgun		
165	.357 magnum revolver		
170	safety airbag		
175	howitzer cannon		
180	rocket launch		
...			
194	sound waves become shock waves		

Most noise levels are given in dBA, which are decibels adjusted to reflect the ear's response to different frequencies of sound. Sudden, brief impulse sounds, like many of those shown at 120 dB or greater, are often given in dB (no adjustment).

Noise Chart

Source: www.noisehelp.com

Appendix B –

White Paper BU-U-019: Sunny Central and Sunny Central Storage Sound Power Measurements on SC/SCSxxxx (-EV) (-US) central inverters

White Paper BU-U-019: Sunny Central and Sunny Central Storage

Sound Power Measurements on SC/SCS xxxx (-EV) (-US) central inverters

Performed by:
SMA Solar Technology AG - Sonnenallee 1 - 34266 Niestetal, Germany - EMC Environment Laboratory (EMV- und Umweltlabor)

Summing up of the Situation

Measurements were taken for one central inverter each of the models SC 2200 and SC 2500-EV. The sound power measurements were performed in accordance with the DIN EN ISO 9614-2:12/1996 standard, "Determination of sound power levels of noise sources using sound intensity".

The measurements were taken under nominal operating conditions for the inverters, with all inverter fans operating at maximum speed.

Inspection Reference According to EN ISO 3744:2011-02

EN ISO 3744 is used as the basis for determining the noise emissions of the unit under test according to EN ISO 12001:05-2007.
As part of the acoustics, it includes the determination of the sound level of noise sources using the enveloping surface method of accuracy class 2 for essentially free field conditions over a reflective plane. Measurements must be carried out in compliance with IEC 551 and DIN EN 45645-1 according to DIN EN ISO 3744. To position the measurement instruments, the enclosure of the unit under test is considered a main radiation area.

Inspection Reference According to EN ISO 9614-2:2010-11

The sound level is determined according to DIN EN ISO 9614-2 "Determination of sound power levels of noise sources using sound intensity", Part 2: "Measurement by scanning".
This measurement procedure keeps interference on the measurement result caused by noises from the environment to a minimum.

Type of Test / Thresholds and Requirements:

Type of Test / Thresholds and Requirements:	Sound level measurement according to DIN EN ISO 3744:2011-02 and DIN EN ISO 9614-2:2010-11 of sinusoidal, irregularly shaped, transient signals. Classification of ambient conditions in compliance with the German Noise Control Guidelines (TA Lärm). (according to Section 2)
Result:	**The requirements were fulfilled.**

Result of Measurements

The following rating levels can be determined from the sound power measurements performed:

Inverter type	Sound power level mean value L_{WA}
SC 1850-US, SCS 1900 SC/SCS 2200 & SC/SCS 2200-US SC/SCS 2475 & SC/SCS 2475-US SCS 2900 & SCS 2900-US	94
SC/SCS 2500-EV, SC/SCS 2500-EV-US SC/SCS 2750-EV, SC/SCS 2750-EV-US SC/SCS 3000-EV	92

The following tables show the selected distances from the inverter and their corresponding sound pressure levels L_{pA} in dB(A) at nominal AC power.

Distance	SC 1850-US, SCS 1900 SC/SCS 2200 & SC/SCS 2200-US SC/SCS 2475 & SC/SCS 2475-US SCS 2900 & SCS 2900-US	SC/SCS 2500-EV & SC/SCS 2500-EV-US SC/SCS 2750-EV & SC/SCS 2750-EV-US SC/SCS 3000-EV
1 m	79	77
10 m	66	64
20 m	60	58
30 m	56	55
40 m	54	52
50 m	52	50
60 m	50	49
70 m	49	47
80 m	48	46
90 m	47	45
100 m	46	44

Information:

The detailed test report may be requested from SMA Solar Technology AG if necessary.