RSK Acoustics

Padbury Brook Solar PV

Noise Impact Assessment

Report 2061200-RSKA-RP-001

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JBM Solar Projects 8 Ltd

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Revision	Description	Date	Prepared	Approved
00	First Draft Issue	19 August 2022	Daniel Vallis	Graeme Parker
01	Final Report	07 September 2022	Daniel Vallis	Graeme Parker
02	Amended Site Plan	26 October 2022	Daniel Vallis	Dan Taylor
03	Minor Amendments	24 November 2022	Daniel Lilley	Daniel Vallis
04	Minor Amendments	16 December 2022	Daniel Vallis	Dan Taylor
05	Minor Amendments	20 December 2022	Robert Bungay	Dan Taylor
06	Updated Emissions Data	05 January 2023	Daniel Vallis	Robert Bungay

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Noise Impact Assessment

1 Introduction

Instruction and Objectives

1.1 RSK Acoustics (RSKA) has been instructed by ADAS Planning, on behalf of JBM Solar Projects 8 Ltd, to undertake a noise assessment to evaluate the operational impact of a proposed solar photovoltaic (PV) development (44 MW, 59.4 hectares) with battery energy storage system (BESS) capability on land to the northeast of Stratton Audley, Bicester OX27 9AJ.

1.2 The assessment benefits from a baseline noise survey, undertaken at positions representative of the nearest noise sensitive receptors (NSRs), to determine typical background noise levels during both daytime and night-time periods.

1.3 This report describes the assessment methodology and the baseline conditions currently prevailing across the application site to evaluate the suitability of the proposed development.

1.4 The aim of this noise assessment is to:

a. Quantify and report the prevailing noise climate at the nearest NSRs to the development;

b. Present relevant impact assessment thresholds from local and national guidelines;

c. Predict the operational noise from the development at nearest NSRs;

d. Assess predicted noise levels against the relevant noise impact thresholds; and

e. Specify noise mitigation measures where necessary.

Site Location and Description

1.5 The site is approximately located within the intersection of the villages of Stratton Audley, Fringford and Godlington, to the northeast of Bicester. The site is predominately arable fields with arable farmland immediately surrounding the site boundary, and broadleaved woodland to the north.

1.6 Beyond the arable fields are several local roads with NSRs situated along these road routes surrounding the proposed development site. Further afield lies the M40 motorway, approximately 6.5 km to the west, and the A421 road, approximately 5 km to the north.

Development Proposals

1.7 The proposed development involves the installation and operation of a renewable energy generating station comprising ground-mounted photovoltaic (PV) solar arrays together with substation, switchgear container, inverter/transformer units, site access, internal access tracks, security measures, access gates, other ancillary infrastructure, and landscaping/biodiversity enhancements.

1.8 The plant shall be capable of operating for a continuous period, with the potential to operate on a 24-hour basis.

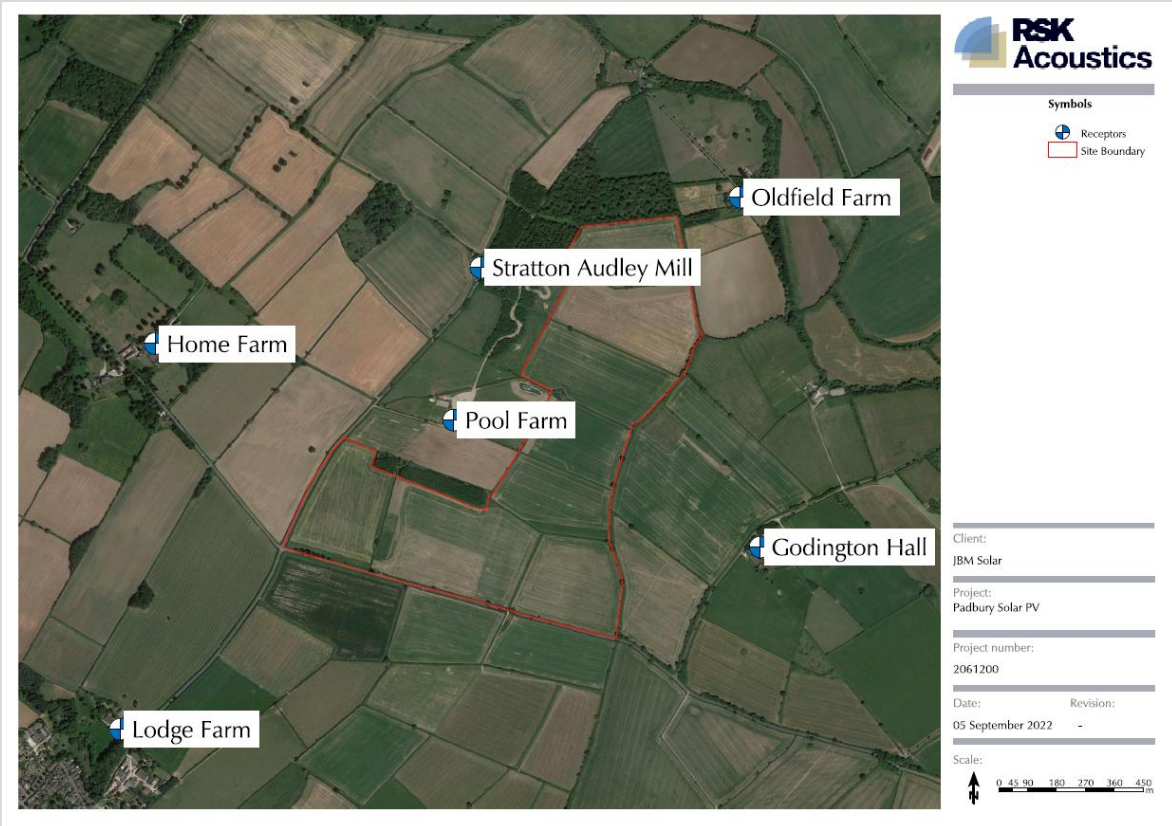
Existing Receptors

1.9 Based on aerial imagery and site attendance, the following NSRs have been used for assessment purposes. NSRs have been chosen based on their position to the development and where necessary, representative of a wider series of NSRs within a settlement.

1.10 A table and map showing the wider site boundary and location of the NSRs considered in the assessment are presented in Table 1 and Figure 1.

NSR Ref.	Description	Lat/Long
NSR1	Godlington Hall	51.93750; -1.08381
NSR2	Home Farm	51.94351; -1.11113
NSR3	Lodge Farm	51.93334; -1.11294
NSR4	Oldfield Farm	51.94744; -1.08437
NSR5	Pool Farm	51.94136; -1.09740
NSR6	Stratton Audley Mill	51.94556; -1.09647

T1 NSR Locations



F1 NSR Locations

2 Relevant Policy and Guidance

Noise Policy Statement for England (NPSE): 2010

2.1 The Noise Policy Statement for England is published by the Department for Environment, Food and Rural Affairs (DEFRA) and sets out the approach to noise within the Government's sustainable development strategy.

2.2 The significance of impacts from noise within the NPSE are defined as follows:

There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

2.3 The three aims of the NPSE are stated as:

"Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

"Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

"Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

National Planning Policy Framework (NPPF): 2021

2.4 Since its publication by the Department for Environment, Food and Rural Affairs in 2010 the Noise Policy Statement for England (NPSE) has been the Central Government noise policy that has been available to inform the consideration of environmental noise in relation to the consenting of everything from small scale residential development to national infrastructure. The National Policy Planning Framework (NPPF), as updated by the Ministry of Housing, Communities and Local Government in 2021, has noise aims that are consistent with NPSE.

2.5 The noise policy aims as stated in NPSE are:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life."*

2.6 In order to translate these aims into practical guidance the NPSE uses the same terminology as used by the World Health Organisation (WHO), in the Night Noise Guidelines for Europe, 2009 by referring to the Lowest Observed Adverse Effect Level (LOAEL). The NPSE extends this concept to define the level above which significant adverse effects on health and quality of life can be detected, hence the Significant Observed Adverse Effect Level (SOAEL).

2.7 The NPSE notes:

"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times".

The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.

2.8 Not having quantified effect thresholds in the NPSE means that relevant standards and guidance are used to put forward values for the LOAEL and SOAEL for the proposed development under consideration.

2.9 The NPPF states:

"Planning policies and decisions should contribute to and enhance the natural and local environment by […] preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans."

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health,

living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…

…Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

British Standard (BS) 7445-1:2003

2.10 The three-part standard BS 7445 'Description and measurement of environmental noise. Guide to quantities and procedures' provides the framework within which environmental noise should be quantified. Part 1 provides a guide to quantities and procedures and Part 2 provides a guide to the acquisition of data pertinent to land use. Part 3 provides a guide to the application of noise limits.

2.11 BS 7445 also refers to a further standard, BS EN 61672, which prescribes the equipment necessary for such measurements. Whilst BS 7445 does not prescribe the meteorological conditions under which noise measurements should or should not be taken, it does (part 2, paragraph 5.4.3.3) recommend that in order:

"…to facilitate the comparison of results (measurements of noise from different sources), it may be necessary to carry out measurements under selected meteorological conditions which are reproducible and correspond to quite stable propagation conditions."

2.12 These conditions include:

- Wind speed not exceeding 5 m/s (measured at a height of 3 m to 11 m above the ground);
- No strong temperature inversions near the ground; and
- No heavy precipitation.

BS 4142:2014+A1:2019

2.13 BS 4142:2014+A1:2019 *'Methods for rating and assessing industrial and commercial sound'* describes the methods for rating and assessing noise of an industrial or commercial nature. The standard is applicable for the purpose of assessing sound from multiple sources at existing dwellings, including the following:

- Sound for industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from the premises or processes, such as that from forklift trucks, or that from train of ship movements on or around an industrial and/or commercial site.

2.14 Where certain acoustic features are present at the assessment location, a character correction should be applied to the specific sound level to give the rating level to be used in the assessment. The difference between the background noise level and the noise rating (including any penalties) is then calculated.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of adverse impact depending on the context.
- Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

2.15 As indicated above, the significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. BS4142 states that:

"An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context".

2.16 Where the initial estimate of the impact needs to be modified due to the context, all pertinent factors should be taken into account, including:

- The absolute level;
- The character and level of the residual sound; and
- The sensitivity of the receptor and whether dwellings will already (or likely) to incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:
- i) façade insulation treatments

- ii) ventilation and/or cooling, and
- iii) acoustic screening.

World Health Organisation Guidelines for Community Noise, 1999

2.17 The World Health Organisation (WHO) Guidelines for Community Noise was published in 2000 as a response to a need for action together with a generic need for improvements in legislation at a national level. Although not legislation, this document provides general guidance and guidelines which have been set for different health effects, using the lowest noise level that produces an adverse health effect in specific human environments.

2.18 The levels which are relevant to this assessment are set out in Table 2 below:

Specific Environment	Critical health effect(s)	$L_{Aeq,T}$ (dB)	Time base, T (hours)	$L_{AF,max}$ (dB)
Outdoor Living Area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50		
Resting	Speech intelligibility and moderate annoyance, daytime and evening	35		
Dwelling, indoors	Sleep disturbance, night-time	30	8	-
Inside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	45[(a)]

(a) Should not exceed 45 dB L_{AFmax} more than 10-15 times a night

T2 WHO Guidelines for Community Noise Levels

3 Noise Survey Method

Survey Measurement Details

3.1 A baseline noise survey was undertaken from Thursday 30 June 2022 to Thursday 07 July 2022. Three unattended measurements (UL1 to UL3) were undertaken over midweek and weekend periods at locations representative of the nearest NSRs.

3.2 Positions were selected by considering the site constraints, security and accessibility of the monitoring equipment to quantify noise from surrounding sources such as the contribution from road and agricultural activity. It was not possible to install the sound level meters within the curtilage of the nearest NSRs and therefore positions were chosen based on their proximity to those receptors. Observations made during installation and collection determined that the noise environment at the monitoring positions was indeed consistent with that witnessed at the nearest receptor locations (to the monitoring position).

3.3 A description of the measurement positions and rationale is provided in Table 3 below:

Location ref.	Type	Location	Co-ordinates
UL1	Unattended	Northern boundary	51.94502, -1.08697
UL2	Unattended	Western boundary	51.94230, -1.09398
UL3	Unattended	Southern boundary	51.93700, -1.09028

T3 Measurement Location Details

3.4 Table 4 and Figure 2 overleaf describes the chosen representative measurement location to each NSR considering the surrounding noise sources.

Reference	Receptor Name	Representative measurement location
NSR1	Godlington Hall	UL3
NSR2	Home Farm	UL2
NSR3	Lodge Farm	UL3
NSR4	Oldfield Farm	UL1
NSR5	Pool Farm	UL2
NSR6	Stratton Audley Mill	UL2

T4 Representative Measurement Location for each NSR

F2 Survey and NSR Locations

Survey Observations

3.5 During the attended portions of the survey, the acoustic environment across the site was observed to comprise the following:

- Birdsong;
- Overhead planes (both high and low);
- Wind through the nearby trees; and
- Noise from occasional road traffic to the south and west.

Survey Equipment

3.6 Noise monitoring was undertaken using the following equipment, detailed in Table 5:

Equipment	Type	Serial Number	Calibration due date
Class 1 sound level meter	Rion NL-52	1021276	30/11/23
Class 1 sound level meter	01dB FUSION	14023	15/06/23
Class 1 sound level meter	Rion NL-52	976250	21/12/23
Acoustic calibrator	Svantek SV33	39661	14/07/22
Acoustic calibrator	Rion NC-74	34615260	25/04/23

T5 Monitoring equipment

3.7 All measurements were undertaken with the microphone positioned away from reflecting surfaces and at a height of 1.5 m above the ground, considered to be under free-field measurement, to the requirements of BS 7445.

3.8 The calibration of each sound level meter was checked before and after the measurements, using the acoustic calibrator at 94 dB at 1 kHz; no significant calibration drift was noted (+/- 0.3 dB).

3.9 The sound level meters used conform to the Class 1 requirements of BS EN 61672-1: 2013 *'Electroacoustics. Sound level meter, Specifications'*. The calibrator used conforms to the requirements of BS EN 60942: 2018 *'Electroacoustics, Sound calibrators'*. The equipment used has a calibration history that is traceable to a certified calibration institution.

Weather Conditions

3.10 Weather conditions during the unattended measurement period were obtained from Wunderground (www.wunderground.com), using the weather station closest to the measuring location (with available historical data), which was judged to be at Fringford Station (IBICES12). This weather data is summarised in Table 6 below.

3.11 Reviewing the data from the survey indicated that, although there were some daily windspeed highs that were greater than 5 m/s, scrutiny of the 30-minute data for each day showed that these highs were short-term and atypical. The summary data within Section 4 does not discriminate between periods in which wind speeds exceeded 5ms^{-1} or showed significant periods of rainfall as it is believed that this does not greatly influence the noise environment.

Date	Temperature High (ºC)	Temperature Low (ºC)	Wind Speed average (m/s)	Wind direction	Accum. precipitation (mm)
30/06/22	19	10	1	SSW	3.56
01/07/22	21	10	1	SW	0.00
02/07/22	19	9	1	SSW	2.29
03/07/22	21	7	1	WSW	0.00
04/07/22	20	7	1	WNW	0.00
05/07/22	21	6	1	WNW	0.00
06/07/22	24	10	1	WNW	8.13

T6 Summarised weather data during monitoring period

4 Survey Results

Long Term Measurements

4.1 Analysis of the dataset accounting for the 16-hour daytime period (07:00 – 23:00) and 8-hour night-time period (23:00 – 07:00) is provided to quantify the noise fluctuations at those positions during a representative period.

Noise Monitoring Position – UL1

4.2 A summary of the measured noise levels at position UL1 are presented in Table 7.

Date	Time period (T)	Measured Noise Levels [b]			
		$L_{Aeq,T}$ dB	$L_{AFmax,T}$ dB	$L_{A90,T}$ dB	$L_{A10,T}$ dB
30/06/22	19:30 - 23:00[a]	38	66	28	38
30/06/22	23:00 - 07:00	47	76	26	40
01/07/22	07:00 - 23:00	48	75	37	48
01/07/22	23:00 - 07:00	42	70	27	37
02/07/22	07:00 - 23:00	50	79	37	48
02/07/22	23:00 - 07:00	47	79	26	39
03/07/22	07:00 - 23:00	50	80	32	48
03/07/22	23:00 - 07:00	43	76	25	36
04/07/22	07:00 - 23:00	44	73	34	45
04/07/22	23:00 - 07:00	45	79	26	39
05/07/22	07:00 - 23:00	45	79	34	44
05/07/22	23:00 - 07:00	44	81	25	37
06/07/22	07:00 - 23:00	47	83	36	47
06/07/22	23:00 - 07:00	46	82	28	38
07/07/22	07:00 - 12:30[a]	42	73	34	44

(a) Measurements not taken throughout full 16hr period

(b) $L_{Aeq,T}$ values are the logarithmic average of $L_{Aeq,15min}$ samples, the $L_{A10,T}$ and $L_{A90,T}$ are the arithmetic average of the $L_{A10,15min}$ and $L_{A90,15min}$ samples, and the $L_{Amax,T}$ is the maximum singular noise level in any 15-minute period

T7 Noise measurement results – UL1

Noise Monitoring Position – UL2

4.3 A summary of the measured noise levels at position UL2 are presented in Table 8.

Date	Time period (T)	Measured Noise Levels [b]			
		$L_{Aeq,T}$ dB	$L_{AFmax,T}$ dB	$L_{A90,T}$ dB	$L_{A10,T}$ dB
30/06/22	15:30 - 23:00[a]	42	69	31	40
30/06/22	23:00 - 07:00	37	59	26	37
01/07/22	07:00 - 23:00	43	72	34	43
01/07/22	23:00 - 07:00	37	58	26	36
02/07/22	07:00 - 23:00	44	72	33	42
02/07/22	23:00 - 07:00	37	59	26	37
03/07/22	07:00 - 23:00	48	75	31	45
03/07/22	23:00 - 07:00	37	57	26	35
04/07/22	07:00 - 23:00	43	69	33	43
04/07/22	23:00 - 07:00	38	61	26	36
05/07/22	07:00 - 23:00	47	73	33	44
05/07/22	23:00 - 07:00	40	63	26	38
06/07/22	07:00 - 23:00	44	71	34	44
06/07/22	23:00 - 07:00	34	56	26	33
07/07/22	07:00 - 11:45[a]	41	70	32	40

(a) Measurements not taken throughout full 16hr period

(b) $L_{Aeq,T}$ values are the logarithmic average of $L_{Aeq,15min}$ samples, the $L_{A10,T}$ and $L_{A90,T}$ are the arithmetic average of the $L_{A10,15min}$ and $L_{A90,15min}$ samples, and the $L_{Amax,T}$ is the maximum singular noise level in any 15-minute period

T8 Noise measurement results – UL2

Noise Monitoring Position – UL3

4.4 A summary of the measured noise levels at position UL3 are presented in Table 9.

Date	Time period (T)	Measured Noise Levels [b]			
		$L_{Aeq,T}$ dB	$L_{AFmax,T}$ dB	$L_{A90,T}$ dB	$L_{A10,T}$ dB
30/06/22	14:30 - 23:00[a]	43	84	33	43
30/06/22	23:00 - 07:00	42	76	26	38
01/07/22	07:00 - 23:00	48	76	38	48
01/07/22	23:00 - 07:00	37	67	28	37
02/07/22	07:00 - 23:00	50	81	38	48
02/07/22	23:00 - 07:00	36	70	26	35
03/07/22	07:00 - 23:00	51	78	33	48
03/07/22	23:00 - 07:00	45	78	25	35
04/07/22	07:00 - 23:00	43	71	35	44
04/07/22	23:00 - 07:00	51	81	25	37
05/07/22	07:00 - 23:00	46	79	34	43
05/07/22	23:00 - 07:00	44	82	25	35
06/07/22	07:00 - 23:00	47	82	37	47
06/07/22	23:00 - 07:00	39	72	27	38
07/07/22	07:00 - 07:30[a]	44	68	35	46

(a) Measurements not taken throughout full 16hr period

(b) $L_{Aeq,T}$ values are the logarithmic average of $L_{Aeq,15min}$ samples, the $L_{A10,T}$ and $L_{A90,T}$ are the arithmetic average of the $L_{A10,15min}$ and $L_{A90,15min}$ samples, and the $L_{Amax,T}$ is the maximum singular noise level in any 15-minute period

T9 Noise measurement results – UL3

4.5 Baseline noise monitoring graphs illustrating the recorded data for the measurement locations are provided in Appendix C.

Derivation of Background Noise Levels

4.6 Given the development is scheduled to operate 24 hours, 7 days a week, the representative background noise levels are provided for day and night-time periods. The methodology detailed in BS 4142: 2014+A1: 2019 provides an example of statistical analysis to determine the representative background noise level during the daytime ($L_{A90,\ 1hr}$) and night-time ($L_{A90,\ 15min}$).

4.7 The analysis adopts the methodologies applied within the aforementioned standard to the receptors below with the representative measurement location background levels. Graphs of the statistical analysis of background levels is shown in Appendix B:

Receptor	Representative Measurement Location	Representative Background Noise Level, $L_{A90,T}$	
		Daytime (07:00-23:00)	Night-time (23:00-07:00)
NSR1	UL3	35	26
NSR2	UL2	32	22
NSR3	UL2	32	22
NSR4	UL1	34	21
NSR5	UL2	32	22
NSR6	UL2	32	22

T10 Receptor background levels

5 Noise Prediction Model

Methodology

5.1 The predicted noise levels likely to be generated during the operational phase of the proposed solar PV development have been calculated using a noise prediction model. These predictions realise the noise propagation of any plant noise in isolation at the nearest sensitive receptors to the site, taking terrain and local topographical features into consideration.

5.2 The noise predictions (specific sound levels at noise sensitive receptors) are based on International Standard ISO 9613-2:1996 '*Attenuation of sound during propagation outdoors – general method of calculation*'. ISO 9613 provides a method for the prediction of noise levels in the community from sources of known sound emission.

5.3 The ISO 9613-2 method predicts noise levels under meteorological conditions favourable to noise propagation from the sound source to the receiver, such as downwind propagation, or equivalently, propagation under a moderate ground-based temperature inversion as commonly occurs at night.

5.4 A computer noise model of the site has been produced using SoundPLAN v8.2 based on site layout information provided by the client, with consideration of the positioning/orientation of all buildings and structures.

5.5 Input data in the form of noise emission levels has been assigned to the proposed plant, adjusted to the geometry and nature of the site operations for the site, with the noise data obtained from previous solar panel planning applications.

5.6 The noise prediction method described in ISO 9613 is suitable for a wide range of engineering applications where the noise level outdoors is of interest. The noise source(s) may be moving or stationary and the method considers the following major mechanisms of noise attenuation:

- Geometrical divergence (also known as distance loss or geometric damping);
- Atmospheric absorption;
- Ground effect;
- Reflection from surfaces; and
- Screening by obstacles, barriers, and buildings.

Modelling Parameters

5.7 An overview of the modelling parameters is given in Table 11.

Item	Setting
Algorithms	International Standard: ISO 9613-2
Façade Corrections	Predictions are at 1 m from a given façade, in free-field conditions. No façade corrections have been applied
Ground Absorption	The ground absorption has been set according to local conditions. Hard ground has been modelled with an absorption coefficient of 0, with soft ground modelled at 0.7, and water around the site with an absorption coefficient of 0.1
Meteorological Conditions	10 degrees Celsius; 70% humidity; and Wind from source to receiver.
Terrain	Surrounding terrain has been derived from NextMap Britain 2m_Contours
Site Layout	Digitised based on site layout provided.

T11 Modelling parameters

Operational Source Noise Data (Unmitigated)

Solar PV Array

5.8 Previous solar panel planning applications completed by RSKA concluded that the primary source of noise emission would be the operation of the inverter stations, which are proposed to be positioned at a variety of locations across this development. The role of an inverter station is to convert DC (direct current) generated from a cluster of solar panels into AC (alternating current) for National Grid and domestic use.

5.9 It is noted that the solar inverters would not be operational outside of daylight periods i.e., when the solar PV panels are not generating electricity.

Battery Energy Storage System (BESS)

5.10 Noise levels of the BESS and BESS DC-DC converter have been provided for the assessment. As it is considered that the development will incorporate a series of DC-to-DC converters for connection to the National Grid from this source as well as from the solar PV panels themselves.

Summary

5.11 The proposals therefore comprise the following (noise-generating) elements for consideration within this assessment:

Component	No. of Units	Make, Model	Sound Pressure Level per Unit, dB L_{PA}	Distance
Solar PV Inverter	8	Sunny Central "2500-EV"	68	10m
BESS	20	CanadianSolar SolBank	75	1m
BESS Inverter	10	Sunny Central "2500-EV"	68	10m
BESS – DC-DC Converter Container	10	SMA DC-DC Converter within container	63[1]	1m
Customer switchgear container	1	Unknown	65	1m

[1] Client data

T12 Sound Data for plant

Operational Assumptions

5.12 It is understood that the site has capability to operate 24 hours per day, 7 days per week. The BESS plant will operate during times when stored power may be discharged into the grid and is considered to operate at full throughout the day and night periods for this assessment. The Solar PV inverters are considered to not operate during night-time hours i.e., when the solar panels are not generating power.

5.13 The components have been calibrated using a receiver positioned at 1 m or 10 m (depending on reference level taken) distance from each of the five emitting surfaces (horizontally and vertically) and at 1.5 m height relative to the ground level (for the non-roof sources) to achieve the reference noise levels summarised in Table 12.

5.14 It is therefore considered that the following assumptions provide a reasonable worst-case scenario whilst accounting for the practical capabilities of the site:

- Daytime (0700-2300) – All units operating; and
- Night-time (2300-0700) – All units operating, with the exception of the solar PV inverters.

6 Operational Noise Impact

Acoustic Correction

6.1 According to BS 4142:2014+A1: 2019, where certain features of the specific noise level can increase the significance of impact of a sound level, a character correction is applied to provide a rated noise level. The characteristics of a sound that are likely to cause an increase in the significance of impact are tonality, impulsivity, intermittency or other characteristic features such as an identifiable 'hiss'.

6.2 Taking the above acoustic features into consideration, the application of rating penalties is detailed below.

Tonality

6.3 Octave band data is not available for the plant items. However, due to the nature of the inverter operations, it is anticipated that each unit would emit a tonal element at 2 times the national grid frequency (50 Hz), amounting to a peak at 100 Hz.

6.4 In accordance with the methodology prescribed within BS 4142, character corrections should be identified for the specific noise level at each receptor rather than at source; consideration should be given to the relative distances between source and receiver and the absolute levels of the sources incident upon the properties.

6.5 On this basis, it is considered that tonal elements may be 'just perceptible' at the nearest NSRs and, as such, a +2 dB penalty for tonal characteristics has been applied during the periods in which the inverters are expected to be operational.

Impulsivity

6.6 The character of the sound from plant items will generally be of a low level and constant, with no rapid change in the level or character of noise. It is therefore considered unnecessary to apply an impulsive correction.

Intermittency

6.7 It is considered that the plant items in combination will not have identifiable on/off conditions, with many items operating at varying loads relative to both the intensity of light incident upon the solar panels and the air temperature. It is therefore considered unnecessary to apply an intermittency correction.

Summary

6.8 Taking account of the character corrections noted above, the calculated Rating Level of the installation is noted to be as follows:

Receptor	Specific Noise Level, $L_{Aeq,T}$	Sum of Character Corrections, dB	Rating Level, $L_{AR,Tr}$
NSR1	41	2	43
NSR2	33	2	35
NSR3	31	2	33
NSR4	42	2	44
NSR5	42	2	44
NSR6	40	2	42

T13 Derivation of Rating Level – Daytime

Receptor	Specific Noise Level, $L_{Aeq,T}$	Sum of Character Corrections, dB	Rating Level, $L_{AR,Tr}$
NSR1	38	2	40
NSR2	31	2	33
NSR3	29	2	31
NSR4	40	2	42
NSR5	40	2	42
NSR6	38	2	40

T14 Derivation of Rating Level – Night-time

Operational Assessment

6.9 The Rating Level (inclusive of penalty corrections) from site activity has been predicted as the contribution (energetic sum) of all active sources within the proposed development up to 1100m. This scenario provides a conservative interpretation of the resulting noise levels at each NSR.

6.10 An assessment of predicted Rating Levels, against the representative background noise at each NSR, is summarised in Tables 16 and 17. In accordance with the procedures within BS 4142:2014 + A1:2019, predicted levels are rounded to integer values.

Receptor	Rating Level, $L_{AR,Tr}$	Representative Background Noise Level, $L_{A90,\ 1hr}$	Excess over Background, dB
NSR1	43	35	+8
NSR2	35	32	+3
NSR3	33	32	+1
NSR4	44	34	+10
NSR5	44	32	+12
NSR6	42	32	+10

T15 Daytime Noise Assessment

Receptor	Rating Level, $L_{AR,Tr}$	Representative Background Noise Level, $L_{A90,\ 15min}$	Excess over Background, dB
NSR1	40	26	+14
NSR2	33	22	+11
NSR3	31	22	+9
NSR4	42	21	+21
NSR5	42	22	+20
NSR6	40	22	+18

T16 Night-time Noise Assessment

Context Evaluation of Significance Criteria

6.11 As indicated previously within this report, the significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.

6.12 BS 4142 states that:

"An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context".

6.13 BS 4142 also states:

"Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following:

1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment *where the residual sound level is high than for an acoustic environment where the residual sound level is low.*

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."

6.14 It is noted that the cumulative noise level from all items operating concurrently does not exceed 50 dB(A) at the nearest NSRs and is therefore not considered to exceed the criterion set out in the WHO guidelines for external amenity spaces.

6.15 Table 17 and Table 18 show the cumulative Rating Level from all operations during the daytime and night-time period, accounting for a nominal -12 dB reduction for a partially open window to predict internal levels.

Receptor	External Level, dB(A)	Internal Level, dB(A)	Excess over WHO Criterion, dB
NSR1	43	31	-4
NSR2	35	23	-12
NSR3	33	21	-14
NSR4	44	32	-3
NSR5	44	32	-3
NSR6	42	30	-5

T17 Evaluation of Daytime Noise Levels against WHO Criteria

Receptor	External Level, dB(A)	Internal Level, dB(A)	Excess over WHO Criterion, dB
NSR1	40	28	-2
NSR2	33	21	-9
NSR3	31	19	-11
NSR4	42	30	+0
NSR5	42	30	+0
NSR6	40	28	-2

T18 Evaluation of Night-time Noise Levels against WHO Criteria

Conservatism in the Assessment

6.16 The following should also be noted when determining the noise impact of the proposed development:

- Whilst the solar panels emit no noise, they would likely act as a partial noise barrier in reducing plant emission levels from the inverters across the site. The actual level of noise reduction would be dependent on the positioning and angle of the panels and, for this reason, the panels were not included in the noise model.

- The assessment accounts for operation of all units simultaneously and at maximum rated power output; consideration should be given to the likelihood of this scenario occurring in reality when evaluating the degree of adverse impact. In reality, the solar PV inverters would only operate when energy is being transferred to the grid and will exhibit noise emissions relative to the power output of the system.

- The SolBank BESS units are noted to produce noise levels no greater than 75dBA at 1m; it is not clear from the manufacturer's datasheet what, specifically, the noise output of these units is, so a pessimistic assumption has been made that 75dBA at 1m is the typical operating status of this type of plant item.

6.17 Given the conservatism outlined above, it is reasonable to assume that operational noise levels associated with the development are likely to be an over-prediction of the realistic noise levels experienced at the surrounding NSRs.

Summary

6.18 The following conclusions can be drawn from the aforementioned assessments:

- When assessing against the criteria set out by BS 4142:2014, predicted Rating Levels from the development are noted to be in excess of 10dB above the prevailing background level. In isolation, this would be:

  "…an indication of a significant adverse impact, depending on the context."

- However, it is noted that the great differences in level shown here are largely due to the low background level recorded during the baseline survey. When considered in the context of the WHO guidelines for environmental noise, the predicted levels are shown to be below the threshold considered to represent adverse impact.

- Furthermore, a number of assumptions have been made with respect to the typical operational capacity of the development that are considered to over-estimate the noise emissions and, subsequently, the degree of impact.

6.19 Accounting for the points raised above, it is considered that the likelihood of significant adverse impact upon the amenity of nearby NSRs is low.

7 Mitigation and Further Action

Mitigation options

7.1 When choosing attenuation measures or implementing an effective noise reduction program, there are two possible approaches for treatment:

- At source – modify the source to radiate at a lower sound power level; and
- In the path – deflect or block the acoustic path of noise.

7.2 As the operation of the solar PV development is unlikely to be able to be changed, then mitigation can be looked at from these two perspectives.

Mitigation at source

7.3 As inverters can be the primary source of continuously radiated discrete tones in a development such as this, attention to initial equipment design can have a major effect on controlling noise emissions at the site. New designs can be specified to have noise emission levels up to 10-20 dB below those levels typical of older models.

7.4 For fans serving to cool units, such as the BESS stations, attenuators can be installed to reduce the level of turbulent airflow noise being emitted.

7.5 Additionally, the use of string inverters rather than central inverters may be suitable to reduce overall noise emissions across the site. Although a greater number of units would be required to serve the development, string inverters individually exhibit lower noise emissions compared to their central counterparts.

7.6 If airflow requirements are not a limiting factor, then a full enclosure may also be an option; depending on construction methods, an enclosure may provide a reduction in noise emissions in excess of 25dB.

Mitigation through transmission

7.7 The construction of an acoustic barrier encompassing the central inverters may reduce the noise emissions by up to 10dB. Barriers should be constructed of a suitably dense material of at least 10 kg/m^2, with no holes or gaps around or underneath, and should be designed to appropriately screen the enclosed unit so there is no direct line of sight from the nearest NSRs. Though due to the height of the proposed plant, the barriers would have to be >3 m to assist with effective noise reduction.

Worked Example

7.8 To provide an indicative example of how such mitigation measures may affect the noise impact of the development, an additional assessment has been completed to achieve parity with the representative background noise levels. Mitigation measures in this scenario include:

- An Enclosure around the solar inverters, BESS inverters and BESS units, resulting in a 20 dBA reduction from them. Subsequently, it is considered that this reduction would also render the tonal elements of the inverter stations less prominent at the NSRs, such that a character correction would no longer be applicable.

7.9 It should be noted that the above measures are indicative only to demonstrate feasibility.

Receptor	Specific Noise Level, $L_{Aeq,T}$	Rating Level, $L_{AR,Tr}$	Excess over Background (BS 4142), dB	Excess over WHO Criterion, dB
NSR1	22	22	-13	-12
NSR2	16	16	-16	-19
NSR3	16	16	-17	-19
NSR4	16	16	-18	-19
NSR5	25	25	-7	-10
NSR6	25	25	-7	-10

T19 Daytime Noise Assessment – Post-Mitigation

Receptor	Specific Noise Level, $L_{Aeq,T}$	Rating Level, $L_{AR,Tr}$	Excess over Background (BS 4142), dB	Excess over WHO Criterion, dB
NSR1	20	20	-6	-10
NSR2	15	15	-7	-15
NSR3	16	15	-6	-14
NSR4	15	20	-6	-15
NSR5	24	24	+2	-6
NSR6	24	19	+2	-6

T20 Night-time Noise Assessment – Post-Mitigation

8 Uncertainty

8.1 BS 4142:2014+A1: 2019 requires that the assessment considers the level of uncertainty in the data and associated calculations. Consideration of the uncertainty can enable a more informed decision regarding the likely significance of impact, within the context of assessment.

8.2 It is accepted that uncertainty may arise from all levels of measurement and assessment and reasonably practicable steps have been made at all stages with the aim of reducing uncertainty.

8.3 The following measures have been taken to reduce uncertainty:

- Background sound level measurements have been obtained at representative assessment locations over a duration of seven days to fully characterise the existing residual environment during the intended operational hours of the proposed development;
- Use of monitoring equipment in accordance with Section 5 of BS 4142: 2014+A1: 2019, using Class 1 instrumentation;
- Measurement procedures followed in accordance with Section 6 of BS 4142: 2014+A1: 2019 with all precautions taken to minimise interference; and
- Specific sound levels have been calculated to the requirements of ISO 9613-2: 1996 which is the widely accepted procedure for the calculation of sound propagation (including favourable wind conditions from source to receiver). The development has yet to be built; therefore, the assessment is informed by comparison of the predicted Rating Levels against the representative background sound levels at each receptor in accordance with Section 7 of BS 4142: 2014+A1: 2019.

8.4 Given the measures outlined above and the magnitude of predicted operational levels in the context of the existing local noise environment, it is considered that the uncertainty does not have any significance on the outcome of the assessment.

8.5 Because the approach taken is likely to be an over-prediction of the noise levels, while there are many uncertainties present in the assessment, it is considered that the outcome (low impact) is unlikely to change.

9 Conclusions

9.1 RSKA was instructed by ADAS Planning, on behalf of JBM Solar Projects 8 Ltd, to undertake a noise assessment to evaluate the operational impact of a proposed solar photovoltaic (PV) development (44 MW, 59.4 hectares) with battery energy storage system (BESS) capability on land to the northeast of Stratton Audley, Bicester.

9.2 A baseline noise survey, undertaken over a seven day period, has been used to determine representative background noise levels at those closest existing receptors to the site, through statistical analysis.

9.3 A computer noise model has been developed which incorporates the representative plant items in operation, including inverters and substation. Predictions account for the cumulative operation of plant items simultaneously during daytime and without solar PV inverters running in the night-time assessment periods.

9.4 The following conclusions can be drawn from the aforementioned assessments:

- When assessing against the criteria set out by BS 4142:2014, predicted Rating Levels from the development are noted to be in excess of 10dB above the prevailing background level.
- However, it is noted that the great differences in level shown here are largely due to the low background level recorded during the baseline survey. When considered in the context of the WHO guidelines for environmental noise, the predicted levels are shown to be below the threshold considered to represent adverse impact.
- Furthermore, a number of assumptions have been made with respect to the typical operational capacity of the development that are considered to over-estimate the noise emissions and, subsequently, the degree of impact.

9.5 Accounting for the points raised above, it is considered that the likelihood of significant adverse impact upon the amenity of nearby NSRs is low.

9.6 Notwithstanding, a preliminary mitigation strategy has been identified with the intention to demonstrate that minimal impact may be achieved. In this scenario, all solar inverters and BESS stations (inclusive of inverters and batteries) have been modelled within enclosures.

9.7 In the context of the site and surrounding area, and taking account of conservatism within the assessment, it is concluded that the principle of development is considered acceptable, assuming that careful consideration of noise emissions is adhered to at the procurement stage of plant items.

End of Section

10 References

1. British Standard 4142: 2014+A1:2019, 'Methods of rating industrial and commercial sound' British Standards Institution.

2. British Standard 7445-1: 2003, 'Description and measurement of environmental noise – Part 1: Guide to quantities and procedures'. British Standards Institution.

3. ISO 9613-2:1996 'Attenuation of sound during propagation outdoors – general method of calculation'. International Organization for Standardization.

4. National Planning Policy Framework – Department for Communities and Local Government. March 2012 (as amended February 2019)

5. Noise Policy Statement for England (NPSE). DEFRA, 2010.

6. World Health Organization (WHO), 'Guidelines for Community Noise', 1999.

End of Section

Glossary of Acoustic Terms

L_p - Sound Pressure Level

The basic unit of sound measurement is the sound pressure level, which is measured on a logarithmic scale and expressed in decibels (dB). The logarithmic scale makes it easier to manage the large range of audible sound pressures, and also more closely represents the way the human ear responds to differences in sound pressure:

$L_p = 20 \log_{10} (p/p_0)$

where p = RMS (root mean square) sound pressure; and

p_0 = reference sound pressure 2×10^{-5} Pa.

Frequency Weighting Networks

Frequency weighting networks, which are generally built into sound level meters, attenuate the signal at some frequencies and amplify it at others. The A-weighting network approximately corresponds to human frequency response to sound. Sound levels measured with the A-weighting network are expressed in dB(A). Other weighting networks also exist, such as C-weighting which is nearly linear (i.e. unweighted) and other more specialised weighting networks. Variables such as L_p and L_{eq} that can be measured using such weightings are expressed as L_{pA} / L_{pC}, L_{Aeq} / L_{Ceq} etc.

Time Weighting

Sound level meters use various averaging times for the measurement of RMS sound pressure level. The most commonly used are fast (0.125 s averaging time), slow (1 s averaging time) and impulse (0.035 s averaging time). Variables that are measures with time weightings are expressed as L_{AFmax} etc.

L_{Aeq} – Equivalent Continuous Sound Pressure Level

Sound levels tend to fluctuate, and as such an ‘instantaneous’ measurement like sound pressure level cannot fully describe many real-world situations. A summation can be made of the measured sound energy over a certain period, and a notional steady level can be calculated which would contain the same total energy as the fluctuating sound. This notional level is termed the equivalent continuous sound level L_{eq}. L_{eq} can be determined over any time period, which is indicated as $L_{eq,T}$ where T is the time period (e.g. $L_{eq,24h}$).

L_{max} - Maximum Sound Pressure Level or Maximum Noise Level

This is the maximum RMS sound pressure level occurring within a specified period. The time weighting is usually specified, such as in L_{Fmax}.

L_n - Percentile or Statistical Levels

It is useful to calculate the level which is exceeded for a certain percent of a total period. Background noise is often defined as the A-weighted sound pressure level exceeded for 90% of the specified period T, expressed $L_{90,T}$. Road traffic noise is often characterised in terms of L_{A10}.

T - Reference Time Interval

The specified interval over which the specific sound level is determined.

Ambient sound

totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. The ambient sound comprises the residual sound and the specific sound when present.

Residual sound

Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

Specific sound source

Sound source being assessed.

$L_{Ar,Tr}$ – Rating level

Specific sound level plus any adjustment for the characteristic features of the sound as per BS 4142:2014+A1:2019. Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level, for example: tonality, impulsivity, intermittency or other sound characteristics that are readily distinctive against the residual acoustic environment.

End of Section

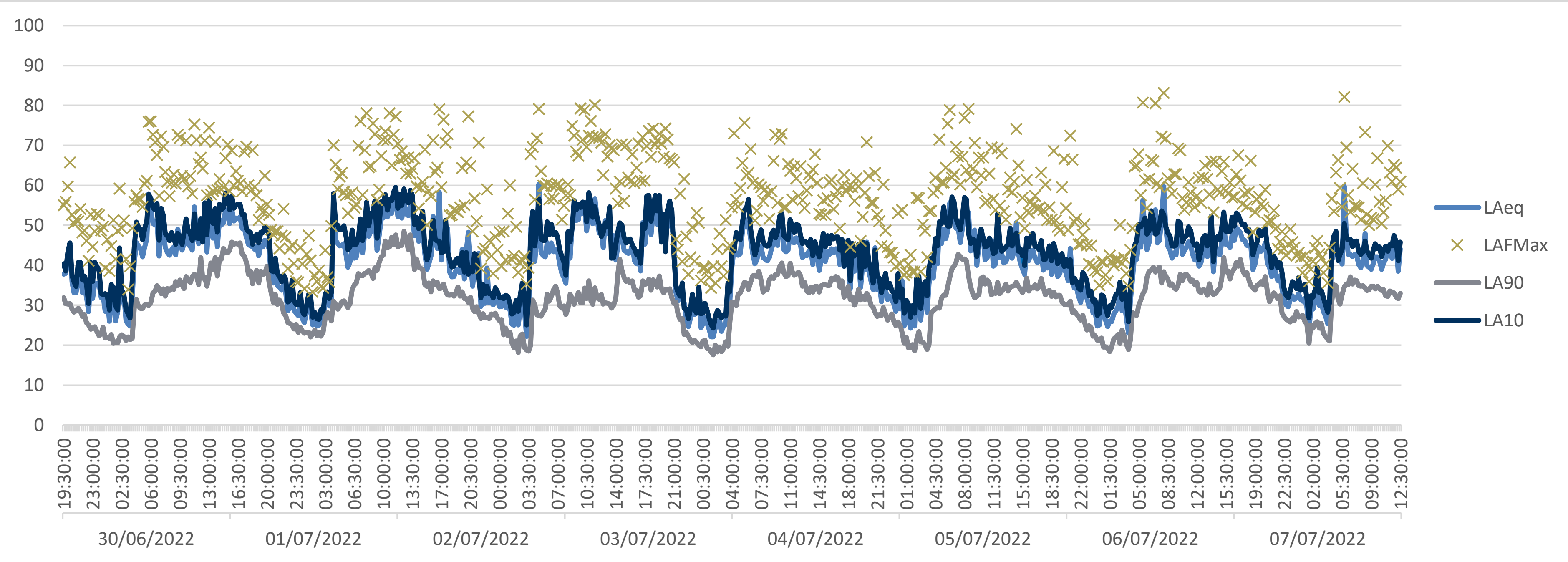
Appendix A: Proposed Site Layout

FA.1 Proposed Site Layout

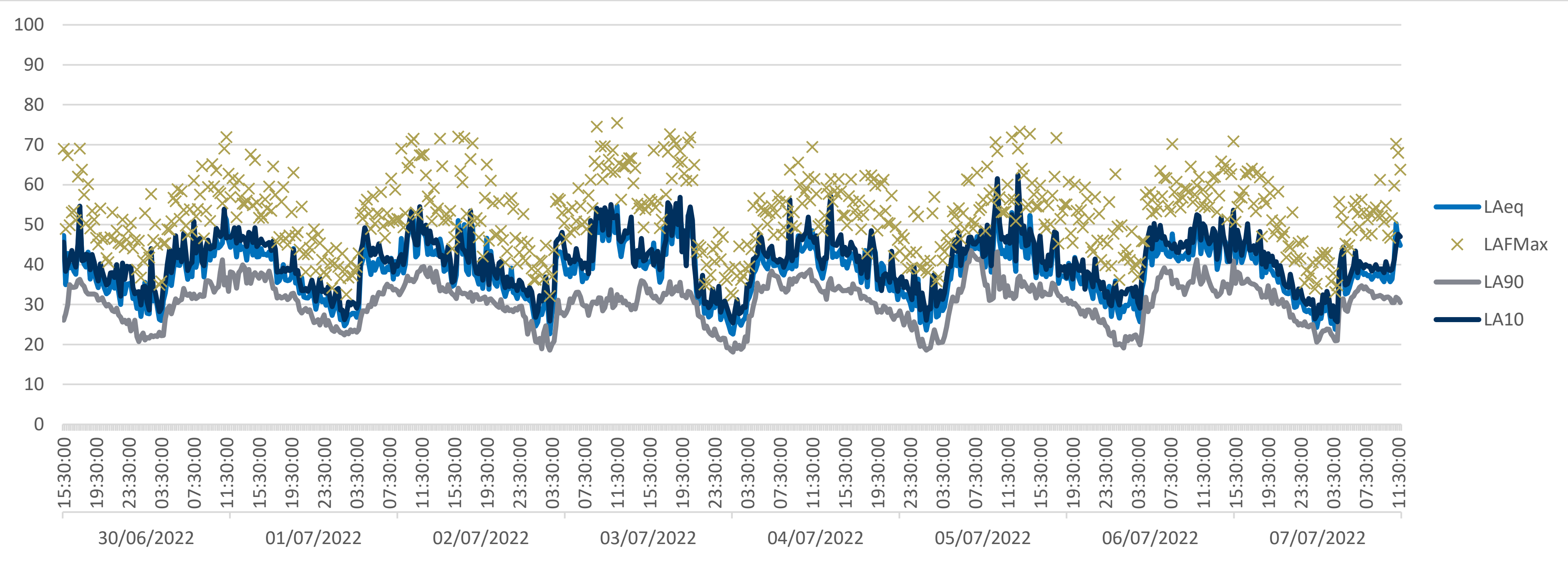
Appendix B: Measurement Location Photographs

Measurement Location	Lat. Long.	Photographs
UL1	51.94502 -1.08697	
UL2	51.94230 -1.09398	
UL3	51.93700 -1.09028	

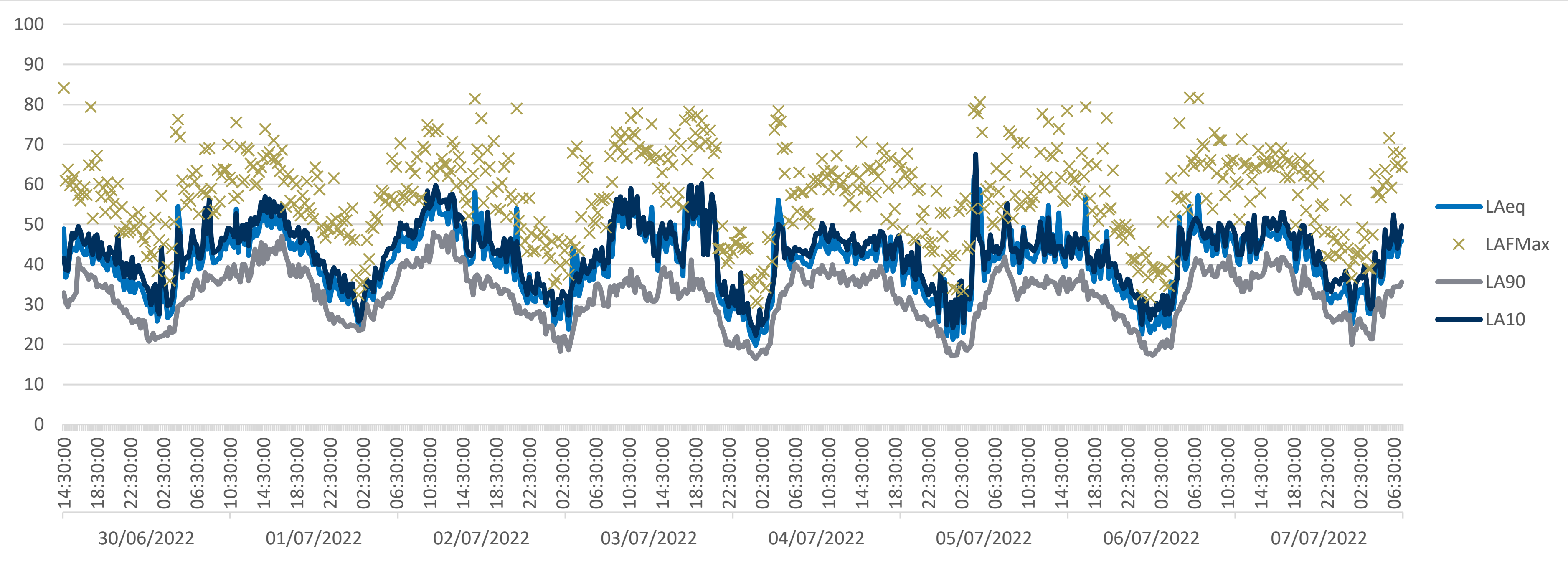
Appendix C: Measured Noise Levels and Background Noise Level Graphs



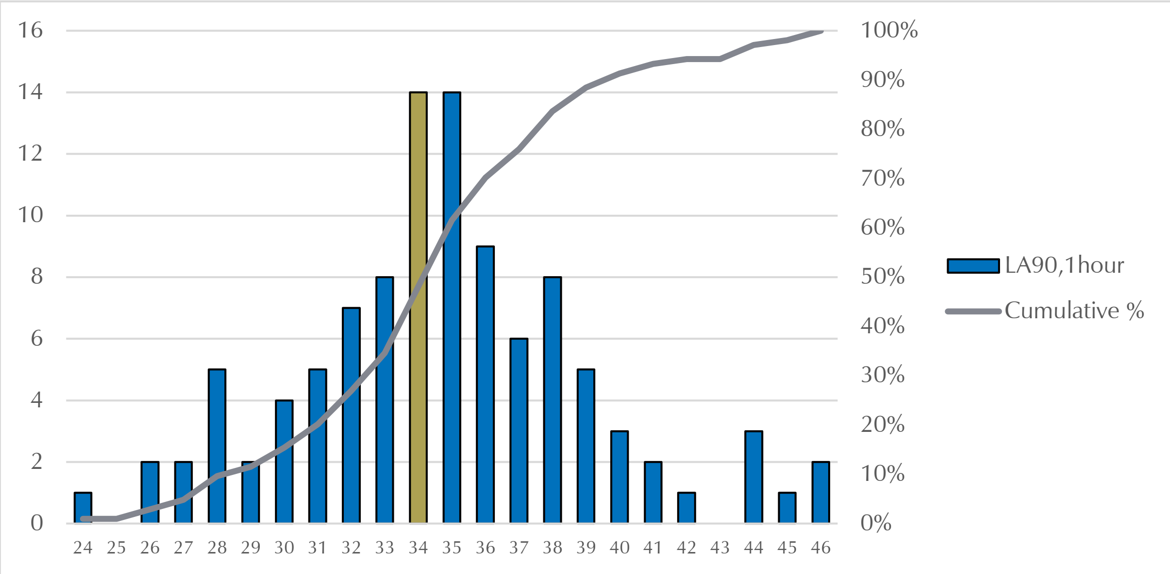
FC.1 Baseline measurement data at UL1



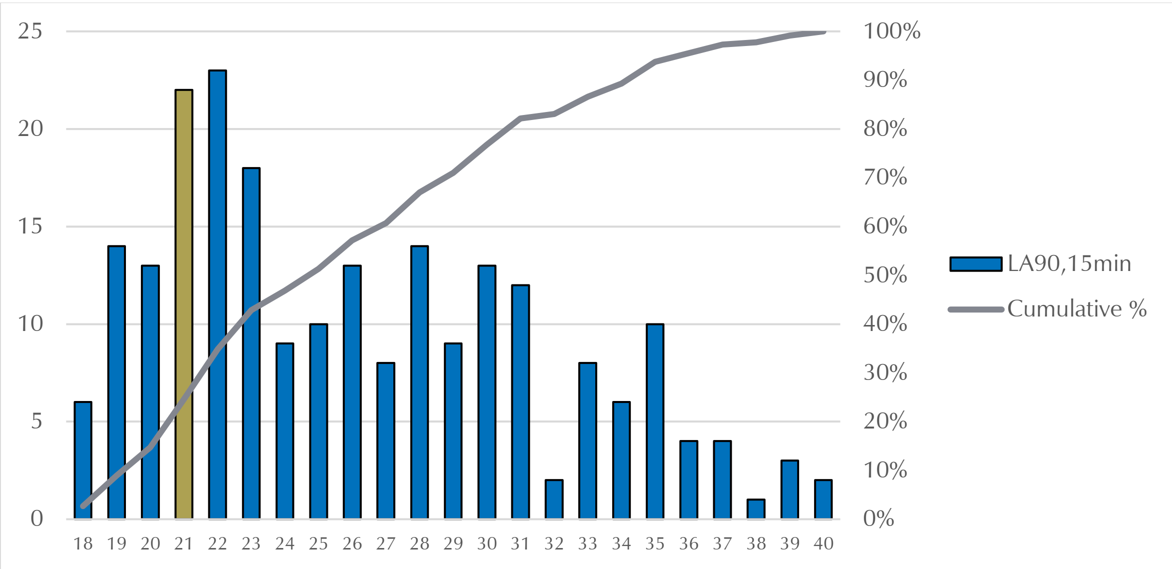
FC.2 Baseline measurement data at UL2



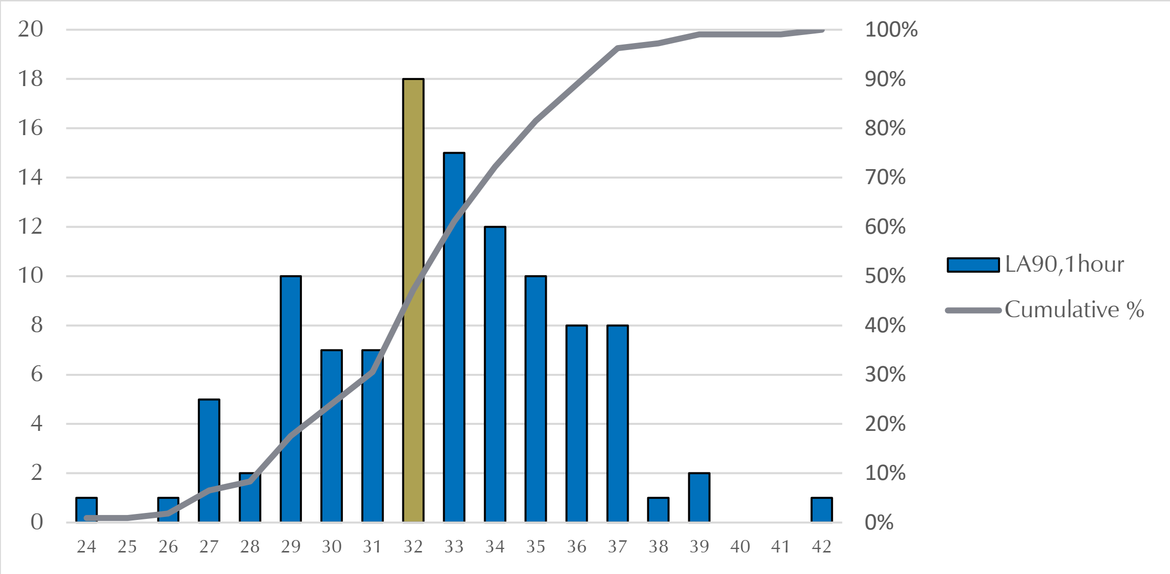
FC.3 Baseline measurement data at UL3



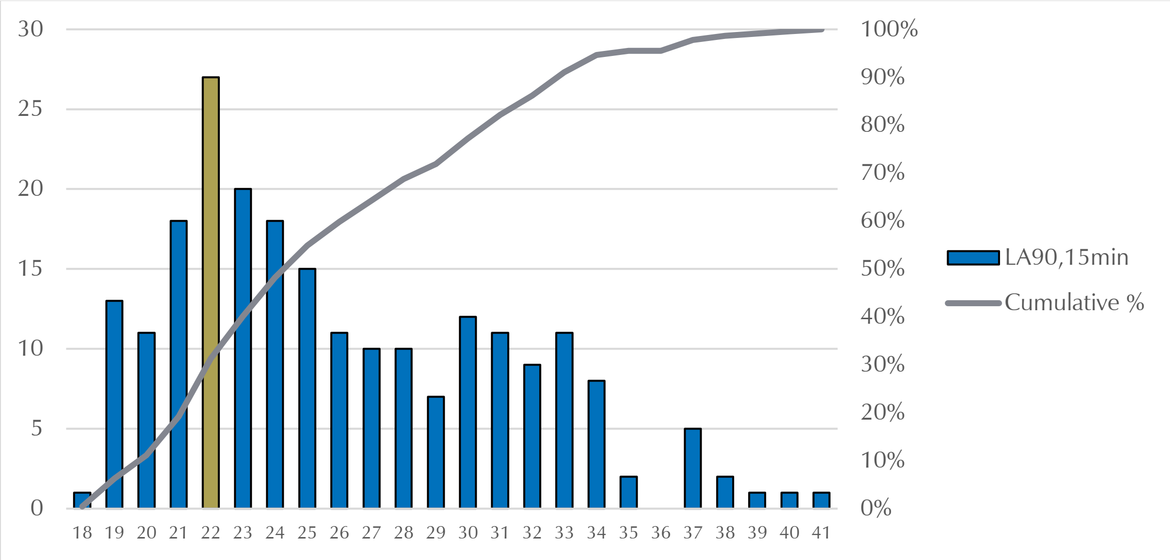
FC.4 Statistical Analysis of Daytime Background Noise Levels – UL1



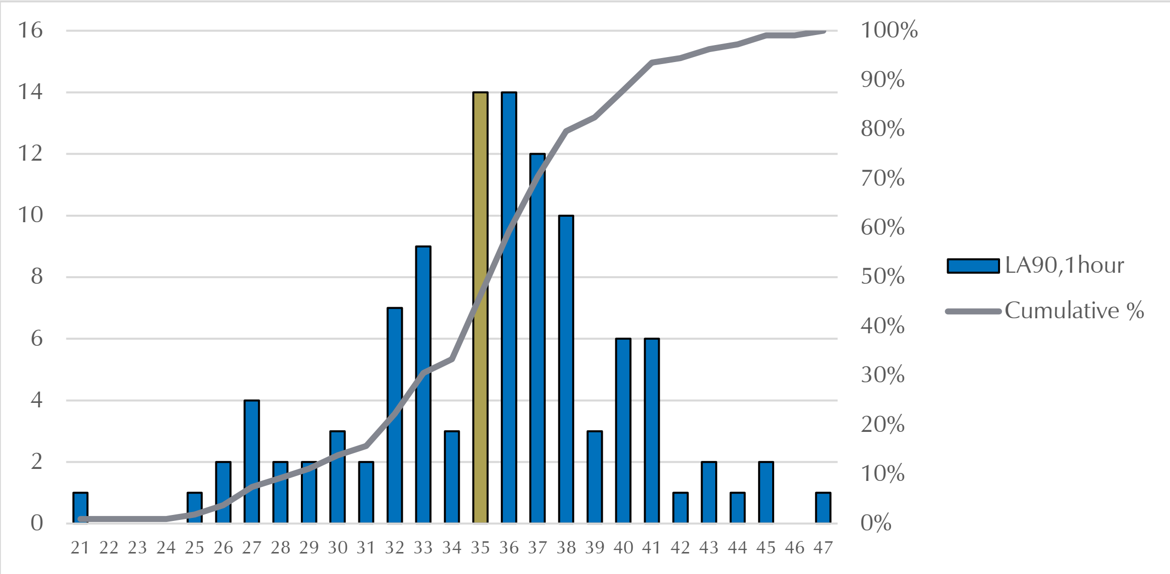
FC.5 Statistical Analysis of Night-time Background Noise Levels – UL1



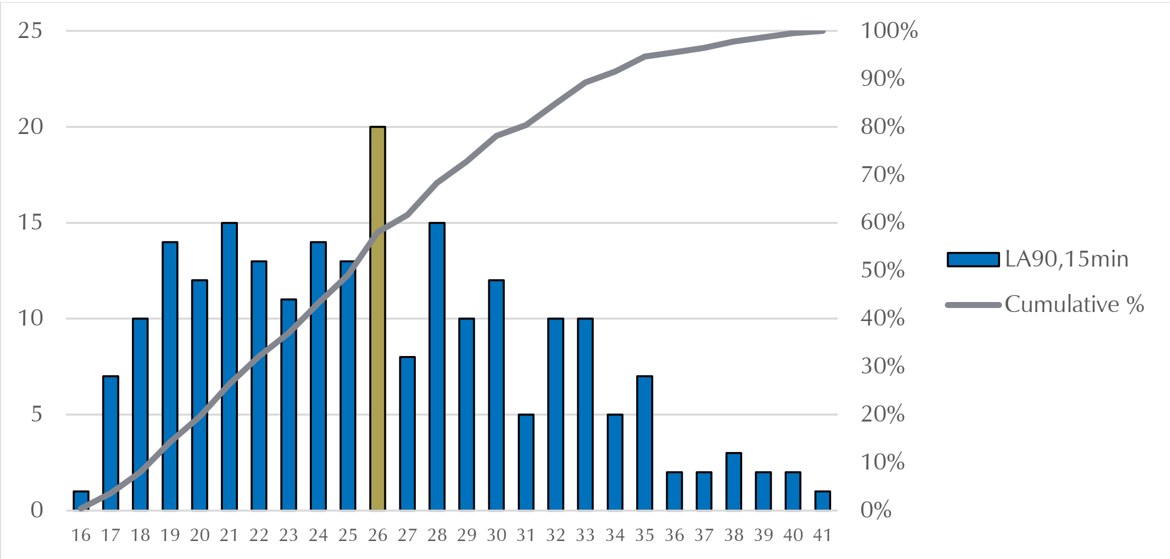
FC.6 Statistical Analysis of Daytime Background Noise Levels – UL2



FC.7 Statistical Analysis of Night-time Background Noise Levels – UL2

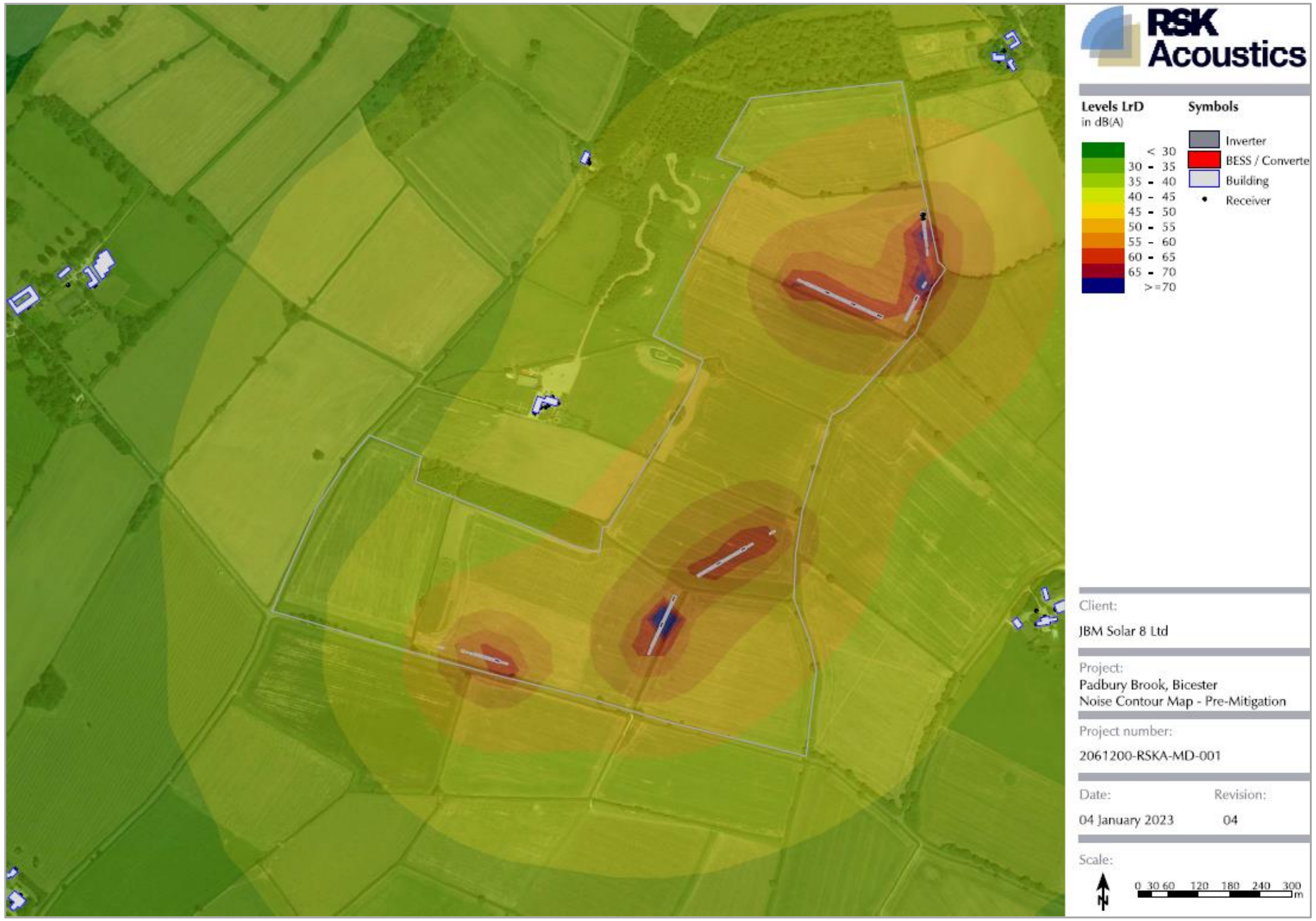


FC.8 Statistical Analysis of Daytime Background Noise Levels – UL3

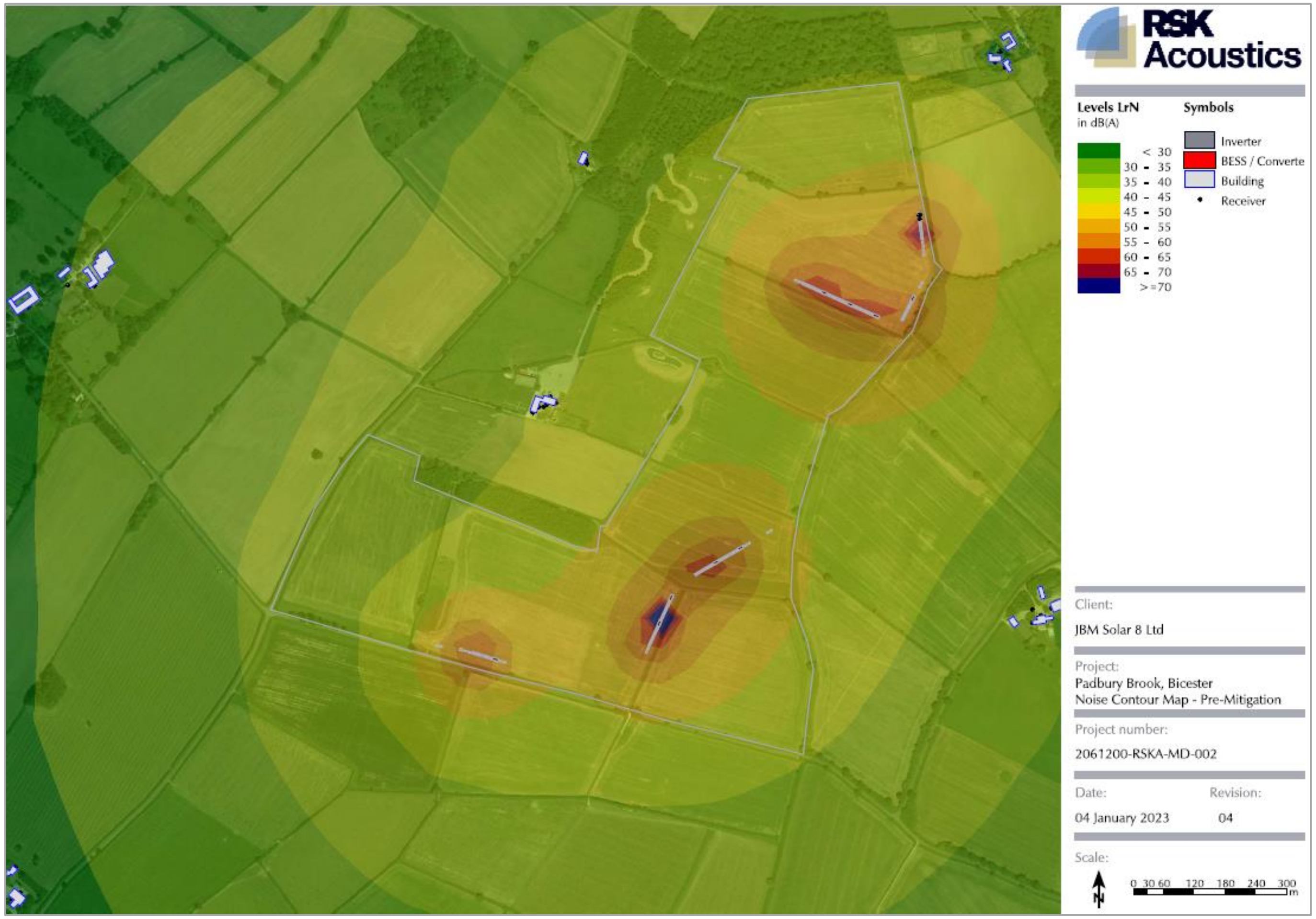


FC.9 Statistical Analysis of Night-time Background Noise Levels – UL3

Appendix D: Model Noise Contours

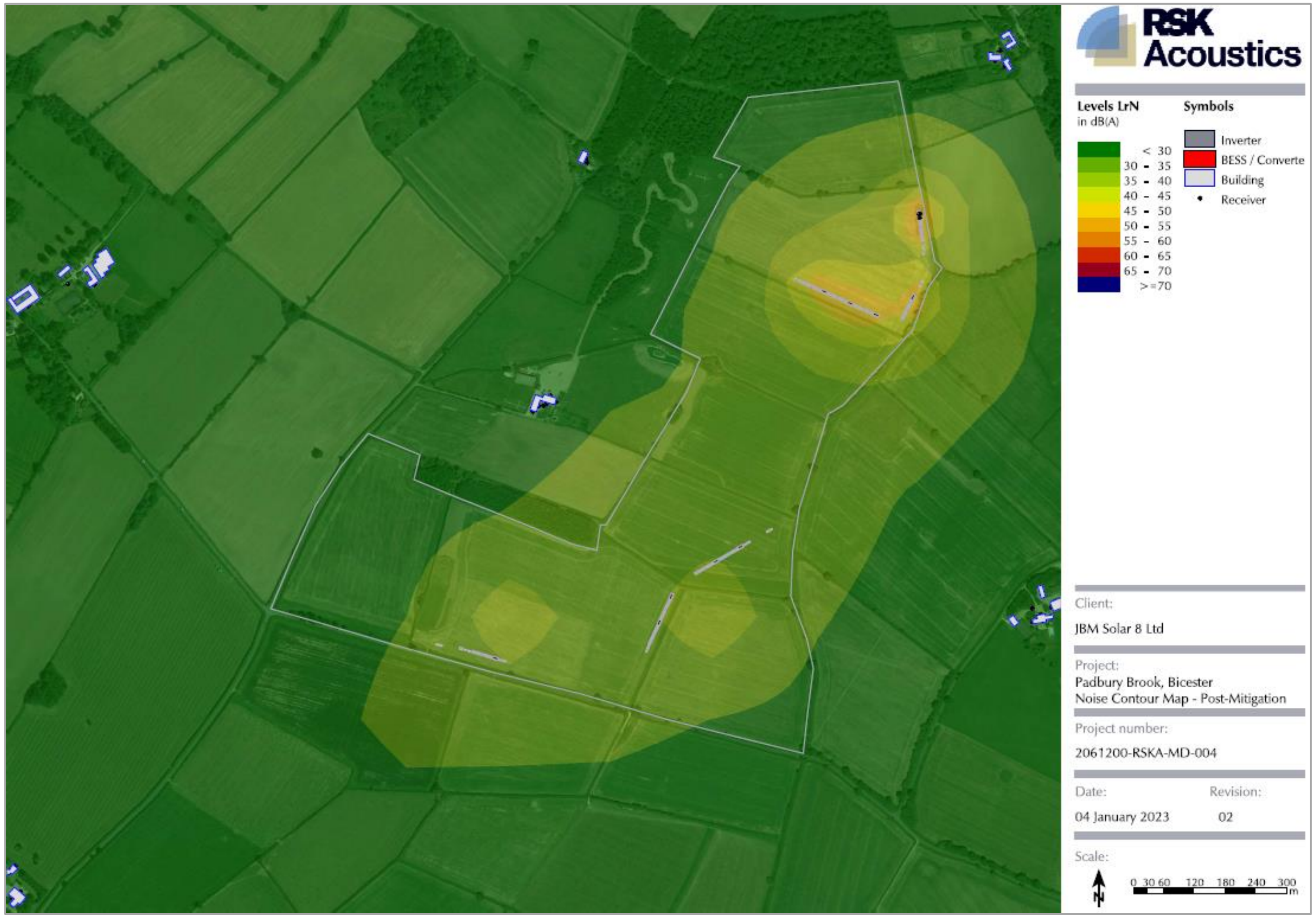


Daytime Noise Contour, Specific Level, Unmitigated Sources



Night-time Noise Contour, Specific Level, Unmitigated Sources

Daytime Noise Contour, Specific Level, Mitigated Sources



Night-time Noise Contour, Specific Level, Mitigated Sources

Appendix E: Plant Data

SUNNY CENTRAL
2200 / 2475 / 2500-EV / 2750-EV / 3000-EV

Efficient
- Up to 4 inverters can be transported in one standard shipping container
- Overdimensioning up to 225% is possible
- Full power at ambient temperatures of up to 35°C

Robust
- Intelligent air cooling system OptiCool for efficient cooling
- Suitable for outdoor use in all climatic ambient conditions worldwide

Flexible
- Conforms to all known grid requirements worldwide
- Q on demand
- Available as a single device or turnkey solution, including medium-voltage block

Easy to Use
- Improved DC connection area
- Connection area for customer equipment
- Integrated voltage support for internal and external loads

SUNNY CENTRAL 2200 / 2475 / 2500-EV / 2750-EV / 3000-EV

The new Sunny Central: more power per cubic meter

With an output of up to 3000 kVA and system voltages of 1100 V DC or 1500 V DC, the SMA central inverter allows for more efficient system design and a reduction in specific costs for PV power plants. A separate voltage supply and additional space are available for the installation of customer equipment. True 1500 V technology and the intelligent cooling system OptiCool ensure smooth operation even in extreme ambient temperature as well as a long service life of 25 years.

SUNNY CENTRAL 1000 V

Technical Data	Sunny Central 2200	Sunny Central 2475
Input (DC)		
MPP voltage range V_{DC} (at 25 °C / at 35 °C / at 50 °C)	570 to 950 V / 800 V / 800 V	638 V to 950 V / 800 V / 800 V
Min. input voltage $V_{DC, min}$ / Start voltage $V_{DC, Start}$	545 V / 645 V	614 V / 714 V
Max. input voltage $V_{DC, max}$	1100 V	1100 V
Max. input current $I_{DC, max}$ (at 35°C / at 50°C)	3960 A / 3600 A	3960 A / 3600 A
Max. short-circuit current $I_{DC, sc}$	6400 A	6400 A
Number of DC inputs	24 double pole fused (32 single pole fused)	
Max. number of DC cables per DC input (for each polarity)	2 x 800 kcmil, 2 x 400 mm²	
Integrated zone monitoring	○	
Available DC fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A	
Output (AC)		
Nominal AC power at cos φ =1 (at 35°C / at 50°C)	2200 kVA / 2000 kVA	2475 kVA / 2250 kVA
Nominal AC power at cos φ =0.8 (at 35°C / at 50°C)	1760 kW / 1600 kW	1980 kW / 1800 kW
Nominal AC current $I_{AC, nom}$ = Max. output current $I_{AC, max}$	3300 A	3300 A
Max. total harmonic distortion	< 3% at nominal power	< 3% at nominal power
Nominal AC voltage / nominal AC voltage range[1) 8)]	385 V / 308 V to 462 V	434 V / 347 V to 521 V
AC power frequency / range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz	
Min. short-circuit ratio at the AC terminals[9)]	> 2	
Power factor at rated power / displacement power factor adjustable[8) 10)]	● 1 / 0.8 overexcited to 0.8 underexcited ○ 1 / 0.0 overexcited to 0.0 underexcited	
Efficiency		
Max. efficiency[2)] / European efficiency[2)] / CEC efficiency[3)]	98.6% / 98.4% / 98.0%	98.6% / 98.4% / 98.0%
Protective Devices		
Input-side disconnection point	DC load break switch	
Output-side disconnection point	AC circuit breaker	
DC overvoltage protection	Surge arrester, type I	
AC overvoltage protection (optional)	Surge arrester, class I	
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III	
Ground-fault monitoring / remote ground-fault monitoring	○ / ○	
Insulation monitoring	○	
Degree of protection: electronics / air duct / connection area (as per IEC 60529)	IP65 / IP34 / IP34	
General Data		
Dimensions (W / H / D)	2780 / 2318 / 1588 mm (109.4 / 91.3 / 62.5 inch)	
Weight	< 3400 kg / < 7496 lb	
Self-consumption (max.[4)] / partial load[5)] / average[6)])	< 8100 W / < 1800 W / < 2000 W	
Self-consumption (standby)	< 300 W	
Internal auxiliary power supply	Integrated 8.4 kVA transformer	
Operating temperature range[8)]	−25°C to 60°C / −13°F to 140°F	
Noise emission[7)]	64.7 dB(A)	
Temperature range (standby)	−40°C to 60°C / −40°F to 140°F	
Temperature range (storage)	−40°C to 70°C / −40°F to 158°F	
Max. permissible value for relative humidity (condensing / non-condensing)	95% to 100% (2 month/year) / 0% to 95%	
Maximum operating altitude above MSL[8)] 1000 m / 2000 m[11)] / 3000 m[11)] / 4000 m[11)]	● / ○ / ○ / ○	
Fresh air consumption	6500 m³/h	
Features		
DC connection	Terminal lug on each input (without fuse)	
AC connection	With busbar system (three busbars, one per line conductor)	
Communication	Ethernet, Modbus Master, Modbus Slave	
Communication with SMA string monitor (transmission medium)	Modbus TCP / Ethernet (FO MM, Cat-5)	
Enclosure / roof color	RAL 9016 / RAL 7004	
Supply transformer for external loads	○ (2.5 kVA)	
Standards and directives complied with	CE, IEC / EN 62109-1, IEC / EN 62109-2, BDEW-MSRL, IEEE1547, UL 840 Cat. IV, Arrêté du 23/04/08	
EMC standards	IEC / EN 61000-6-2, FCC Part 15 Class A, Cispr 11, DIN EN55011:2017	
Quality standards and directives complied with	VDI/VDE 2862 page 2, DIN EN ISO 9001	
● Standard features ○ Optional		
Type designation	SC-2200-10	SC-2475-10

1) At nominal AC voltage, nominal AC power decreases in the same proportion
2) Efficiency measured without internal power supply
3) Efficiency measured with internal power supply
4) Self-consumption at rated operation
5) Self-consumption at < 75% Pn at 25°C
6) Self-consumption averaged out from 5% to 100% Pn at 25°C
7) Sound pressure level at a distance of 10 m
8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
9) A short-circuit ratio of < 2 requires a special approval from SMA
10) Depending on the DC voltage
11) Earlier temperature-dependent de-rating and reduction of DC open-circuit voltage

SUNNY CENTRAL 1500 V

Technical Data	Sunny Central 2500-EV	Sunny Central 2750-EV	Sunny Central 3000-EV
Input (DC)			
MPP voltage range V_{DC} (at 25 °C / at 35 °C / at 50 °C)	850 V to 1425 V / 1200 V / 1200 V	875 V to 1425 V / 1200 V / 1200 V	956 V to 1425 V / 1200 V / 1200 V
Min. input voltage $V_{DC, min}$ / Start voltage $V_{DC, Start}$	778 V / 928 V	849 V / 999 V	927 V / 1077 V
Max. input voltage $V_{DC, max}$	1500 V	1500 V	1500 V
Max. input current $I_{DC, max}$ (at 35 °C / at 50 °C)	3200 A / 2956 A	3200 A / 2956 A	3200 A / 2970 A
Max. short-circuit current rating	6400 A	6400 A	6400 A
Number of DC inputs	24 double pole fused (32 single pole fused) for PV		
Number of DC inputs with optional DC coupled storage	18 double pole fused (36 single pole fused) for PV and 6 double pole fused for batteries		
Max. number of DC cables per DC input (for each polarity)	2 x 800 kcmil, 2 x 400 mm²		
Integrated zone monitoring	○		
Available DC fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A		
Output (AC)			
Nominal AC power at cos φ =1 (at 35 °C / at 50 °C)	2500 kVA / 2250 kVA	2750 kVA / 2500 kVA	3000 kVA / 2700 kVA
Nominal AC power at cos φ =0.8 (at 35 °C / at 50 °C)	2000 kW / 1800 kW	2200 kW / 2000 kW	2400 kW / 2160 kW
Nominal AC current $I_{AC, nom}$ = Max. output current $I_{AC, max}$	2624 A	2646 A	2646 A
Max. total harmonic distortion	< 3% at nominal power	< 3% at nominal power	< 3% at nominal power
Nominal AC voltage / nominal AC voltage range[1] [8]	550 V / 440 V to 660 V	600 V / 480 V to 720 V	655 V / 524 V to 721 V[9]
AC power frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz		
Min. short-circuit ratio at the AC terminals[10]	> 2		
Power factor at rated power / displacement power factor adjustable[8] [11]	● 1 / 0.8 overexcited to 0.8 underexcited ○ 1 / 0.0 overexcited to 0.0 underexcited		
Efficiency			
Max. efficiency[2] / European efficiency[2] / CEC efficiency[3]	98.6% / 98.3% / 98.0%	98.7% / 98.5% / 98.5%	98.8% / 98.6% / 98.5%
Protective Devices			
Input-side disconnection point	DC load-break switch		
Output-side disconnection point	AC circuit breaker		
DC overvoltage protection	Surge arrester, type I & II		
AC overvoltage protection (optional)	Surge arrester, class I & II		
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III		
Ground-fault monitoring / remote ground-fault monitoring	○ / ○		
Insulation monitoring	○		
Degree of protection: electronics / air duct / connection area (as per IEC 60529)	IP65 / IP34 / IP34		
General Data			
Dimensions (W / H / D)	2780 / 2318 / 1588 mm (109.4 / 91.3 / 62.5 inch)		
Weight	< 3400 kg / < 7496 lb		
Self-consumption (max.[4] / partial load[5] / average[6])	< 8100 W / < 1800 W / < 2000 W		
Self-consumption (standby)	< 370 W		
Internal auxiliary power supply	Integrated 8.4 kVA transformer		
Operating temperature range[8]	−25 to 60 °C / −13 to 140 °F		
Noise emission[7]	67.8 dB(A)		
Temperature range (standby)	−40 to 60 °C / −40 to 140 °F		
Temperature range (storage)	−40 to 70 °C / −40 to 158 °F		
Max. permissible value for relative humidity (condensing / non-condensing)	95% to 100% (2 month / year) / 0 % to 95%		
Maximum operating altitude above MSL[8] 1000 m / 2000 m[12] / 3000 m[12]	● / ○ / –	● / ○ / –	● / ○ / –
Fresh air consumption	6500 m³/h		
Features			
DC connection	Terminal lug on each input (without fuse)		
AC connection	With busbar system (three busbars, one per line conductor)		
Communication	Ethernet, Modbus Master, Modbus Slave		
Communication with SMA string monitor (transmission medium)	Modbus TCP / Ethernet (FO MM, Cat-5)		
Enclosure / roof color	RAL 9016 / RAL 7004		
Supply transformer for external loads	○ (2.5 kVA)		
Standards and directives complied with	CE, IEC / EN 62109-1, IEC / EN 62109-2, BDEW-MSRL, IEEE1547, Arrêté du 23/04/08		
EMC standards	EN55011:2017, IEC/EN 61000-6-2, FCC Part 15 Class A		
Quality standards and directives complied with	VDI/VDE 2862 page 2, DIN EN ISO 9001		
● Standard features ○ Optional – not available			
Type designation	SC-2500-EV-10	SC-2750-EV-10	SC-3000-EV-10

1) At nominal AC voltage, nominal AC power decreases in the same proportion
2) Efficiency measured without internal power supply
3) Efficiency measured with internal power supply
4) Self-consumption at rated operation
5) Self-consumption at < 75% Pn at 25 °C
6) Self-consumption averaged out from 5% to 100% Pn at 35 °C
7) Sound pressure level at a distance of 10 m
8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
9) AC voltage range can be extended to 753V for 50Hz grids only (option „Aux power supply: external" must be selected, option "housekeeping" not combinable).
10) A short-circuit ratio of < 2 requires a special approval from SMA
11) Depending on the DC voltage
12) Available as a special version, earlier temperature-dependent de-rating and reduction of DC open-circuit voltage

SUNNY CENTRAL 1500 V

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Integrated zone monitoring	○		
Available DC fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A		
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Input-side disconnection point	DC load-break switch		
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DC overvoltage protection	Surge arrester, type I & II		
AC overvoltage protection (optional)	Surge arrester, class I & II		
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III		
Ground-fault monitoring / remote ground-fault monitoring	○ / ○		
Insulation monitoring	○		
Degree of protection: electronics / air duct / connection area (as per IEC 60529)	IP65 / IP34 / IP34		
General Data			
Dimensions (W / H / D)	2780 / 2318 / 1588 mm (109.4 / 91.3 / 62.5 inch)		
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Max. permissible value for relative humidity (condensing / non-condensing)	95% to 100% (2 month / year) / 0 % to 95%		
Maximum operating altitude above MSL[8] 1000 m / 2000 m[12] / 3000 m[12]	● / ○ / –	● / ○ / –	● / ○ / –
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Features			
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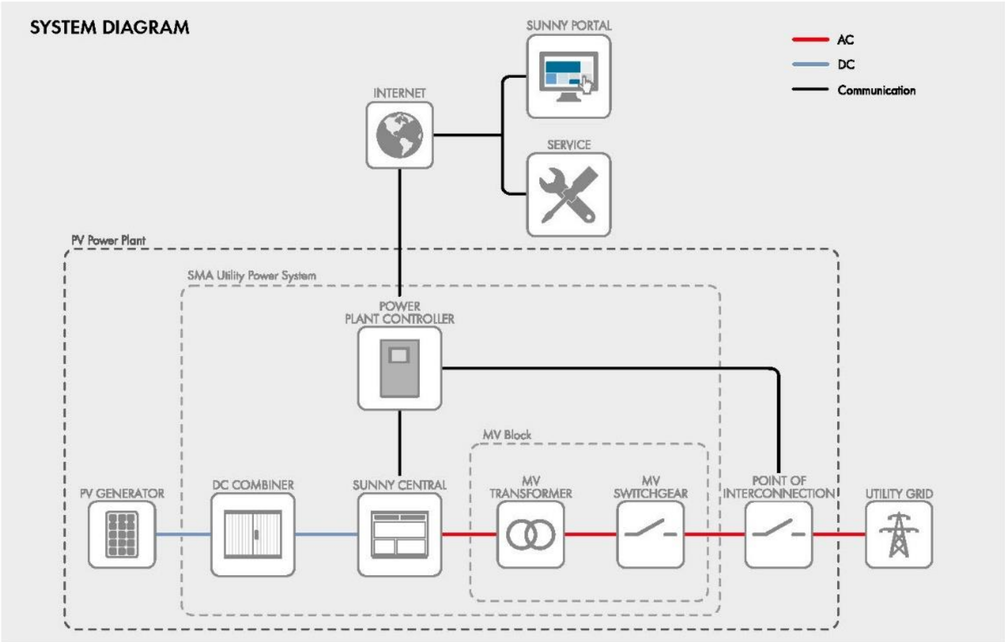

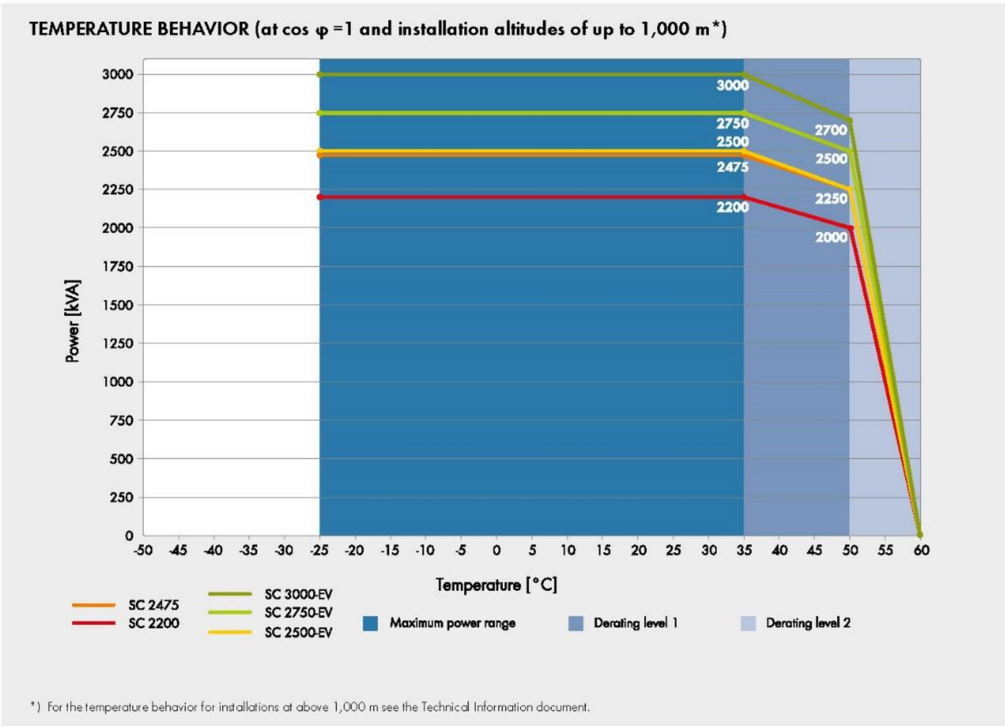

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BESS Datasheet

NEW

CanadianSolar

SolBank

Energy Storage System

S1K51K3A02

Canadian Solar SolBank is a modular, flexible, dedicated, simple and cost-effective MWh-scale battery energy storage system. Multiple SolBank energy storage systems can be expanded in parallel to meet today's energy storage needs and prepare for the future' s requirements.

KEY FEATHERS

- LFP 280Ah cell, long service life, cost-effective, safe and reliable
- High area energy density
- Active balancing BMS on pack and rack level, releases more energy and extends the life of the system
- Liquid cooling technology with design redundancy, cell temperature controlled within the optimal operating range
- Battery pack IP65 seal grade, avoid dust, moisture, and water condensation
- Multi-stage thermal spread protection technology, effectively prevents battery heat spread and improves safety
- Multi-level fire detection, monitor early thermal runaway of cells
- All internal components including batteries assembled in factory, reduced shipping costs and on-site installation workload

PRODUCT CERTIFICATES*

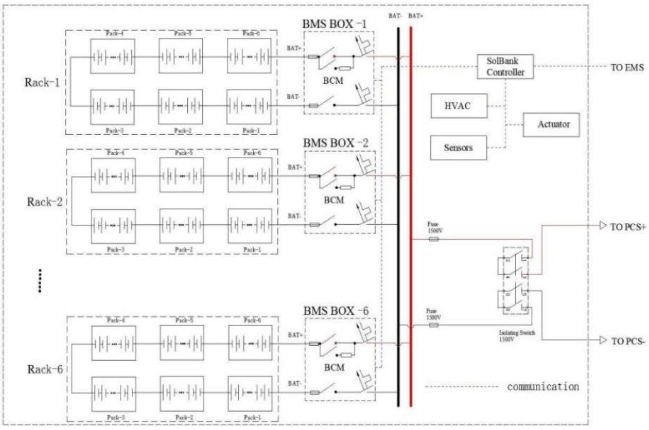
UL1973, UL9540, UL9540A, UN38.3 / UN3536

* The specific certificates applicable to different module types and markets will vary, and therefore not all of the certifications listed herein will simultaneously apply to the products you order or use. Please contact your local Canadian Solar sales representative to confirm the specific certificates available for your Product and applicable in the regions in which the products will be used.

CSI Solar Co., Ltd. is committed to providing high quality solar photovoltaic modules, solar energy and battery storage solutions to customers. The company was recognized as the No. 1 module supplier for quality and performance/price ratio in the IHS Module Customer Insight Survey. Over the past 20 years, it has successfully delivered over 67 GW of premium-quality solar modules across the world.

CSI Energy Storage Co., Ltd.
348 Lushan Road, SND, Suzhou, Jiangsu, China, 215129, www.csisolar.com, support@csisolar.com

CIRCUIT DIAGRAM



SYSTEM PARAMETER

	S1K51K3A02
Battery Chemistry	Lithium Iron Phosphate (LFP)
Pack Configuration	1P69S (69 Cells)
Rack Configuration	1P414S (6 Packs)
System Configuration	6P414S (6 Racks)
DC Voltage (Nominal)	1324.8 V
DC Voltage Range[1]	1159.2 V ~ 1490.4 V
Rated DC Power[2]	1273 kW
Usable Energy Capacity (FAT)[3]	1900 kWh
Max. Short Circuit Current	60 kA
Charging/Discharging Mode	0.67 P / 0.67 P
Duration @Rated Power	1.5 hrs
DC Round Trip Efficiency (RTE)[4]	⩾ 90%
Aux Load (Standby/Peak)	1.25 kVA / 37.5 kVA
Auxiliary Power Interface	AC480 V / 60 Hz, 3P5W
Thermal Management System	Liquid cooling/heating for battery system, air cooling for electrical components and humidity control
Auxiliary Backup Power[5]	2-hrs UPS, installed in the container
Operating Temperature (Ambient)	-30 °C to 55 °C
Relative Humidity	⩽95% (non-condensing)
Communication Interface	Ethernet / RS485 / CAN
Communication Protocol	Modbus TCP / Modbus RTU / CAN 2.0
Certifications	UL1973, UL9540, UL9540A, UN38.3 / UN3536
Design Standards/Codes	IEC62619, IEC61000, NFPA69, NFPA70, NFPA855, IEC62620
Enclosure	20ft. high-cube container
Dimensions (L*W*H)	6058*2438*2896 mm (238.50*95.98*114.02 in)
Weight (Battery Included)	24400 kg (53,800 lbs)
Altitude	< 2000 m (derating between 2000 m ~ 4000 m)
Enclosure Ingress Rating	IP55 / NEMA 3R
Painting/Coating	RAL9003
Seismic Parameter	Zone 4
Noise @1m distance	⩽ 75 dB
Fire Detection	Heat and smoke detection
Explosion Prevention & Mitigation	Gas detection with active ventilation
Fire Alarm	Alarm panel, strobes, and horns with UPS backup
Local Emergency Stop	Yes
Remote Stop/Shut-off	Yes

1. Maximum voltage range value
2. The parameter value is the maximum operating power of a single SolBank. When two units are connected in parallel, the operating power of a single SolBank needs to be derated by 5%.
3. Usable Energy Capacity is measured at the DC bus, contact CSI for an accurate estimate
4. RTE is measured at rated DC Power operation, excluding auxiliary load
5. Backup power supports control system only, including fire detection and alarm, BMS

* The technical parameters contained in this technical data document may deviate slightly, and Canadian Solar does not guarantee that they are completely accurate. Due to continuous innovation, research and development and product improvement, Canadian Solar reserves the right to adjust the information in this technical parameter document at any time without prior notice. The customer should obtain the latest version of the technical parameter document when signing the contract and make it an integral part of the binding contract signed by both parties.

PARTNER SECTION

CSI Energy Storage Co., Ltd.
348 Lushan Road, SND, Suzhou, Jiangsu, China, 215129, www.csisolar.com, support@csisolar.com

DC-DC Container Noise Levels

Robert Bungay

From:	
Sent:	19 December 2022 15:51
To:	Robin Johnson; Robert Bungay
Cc:	Jacques Carboni; Kenny Dhillon; Daniel Vallis
Subject:	RE: Padbury Brook Noise Assessment [Filed 19 Dec 2022 16:06]
Categories:	Filed by Mail Manager

Hi Robert,

Our containerised solution emits 63dBA at 1m.

I hope this helps,

Kind regards,

Hattie

Hattie Wade
Design Engineer

Mobile
Web www.jbm-solar.com
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33 Broadwick St, London, W1F 0DQ

JBM SOLAR

Solar Energy UK

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