Report

Acoustic Services

MOKOAN SOLAR FARM – NOISE EMISSION ASSESSMENT

Urbis Pty Ltd

Report

CONFIDENTIAL

Revision: 5.1 – FOR INFORMATION
Issued: 12 January 2024

Norman Disney & Young
A TETRA TECH COMPANY

Table of Contents

1 EXECUTIVE SUMMARY

1.1 Introduction

This report outlines the acoustic assessment for the proposed Mokoan Solar Farm Project against the requirements of the EPA Publication 1826.4 - Part I. The project is a 40 MW extension to an approved 15MW solar farm in Winton, regional Victoria.

The boundary of the solar farm is approximately 280m from the nearest residential receiver.

This report addresses the noise emitted from the site.

1.2 Authority

Authority to undertake this report was provided by Jon Mills of Urbis.

1.3 Information Sources

The report is based upon the following information:

- EPA Publication 1826.4 - Part I: Commercial, Industrial and Trade Premises
- Robert Bird Group Preliminary Design Layout LP2-PDL dated revision 22 dated 15/11/23
- HEMK Solar Inverter Technical Data
- Feedback from Urbis dated 12th June 2020

1.4 Revision History

	Date Issued	Comment
1.0	24 April 2020	For Information
2.0	28 April 2020	For Information – response to client comments
3.0	17 July 2020	For Information – response to client comments
4.0	9 June 2022	For Information
5.0	20 December 2023	For Information – new selections and layout
5.1	12 January 2023	For Information – minor updates

1.5 Changes since last revision

The following changes have been made since the last major revision:

- Updated noise emission criteria to reflect EPA Publication 1826.4 – Part I: Commercial, Industrial and Trade Premises
- New inverter selections
- Updated layout
- Recommendation for acoustic barriers around PCU

2 SITE LOCATION AND ENVIRONMENTAL NOISE CRITERIA

2.1 Location and Zoning

The site is located in the Benalla Rural City. The location of the site (aerial masterplan and planning zoning) are shown in the figures below. The solar farm site is located in FZ Farm Zone according to the EPA Guideline.

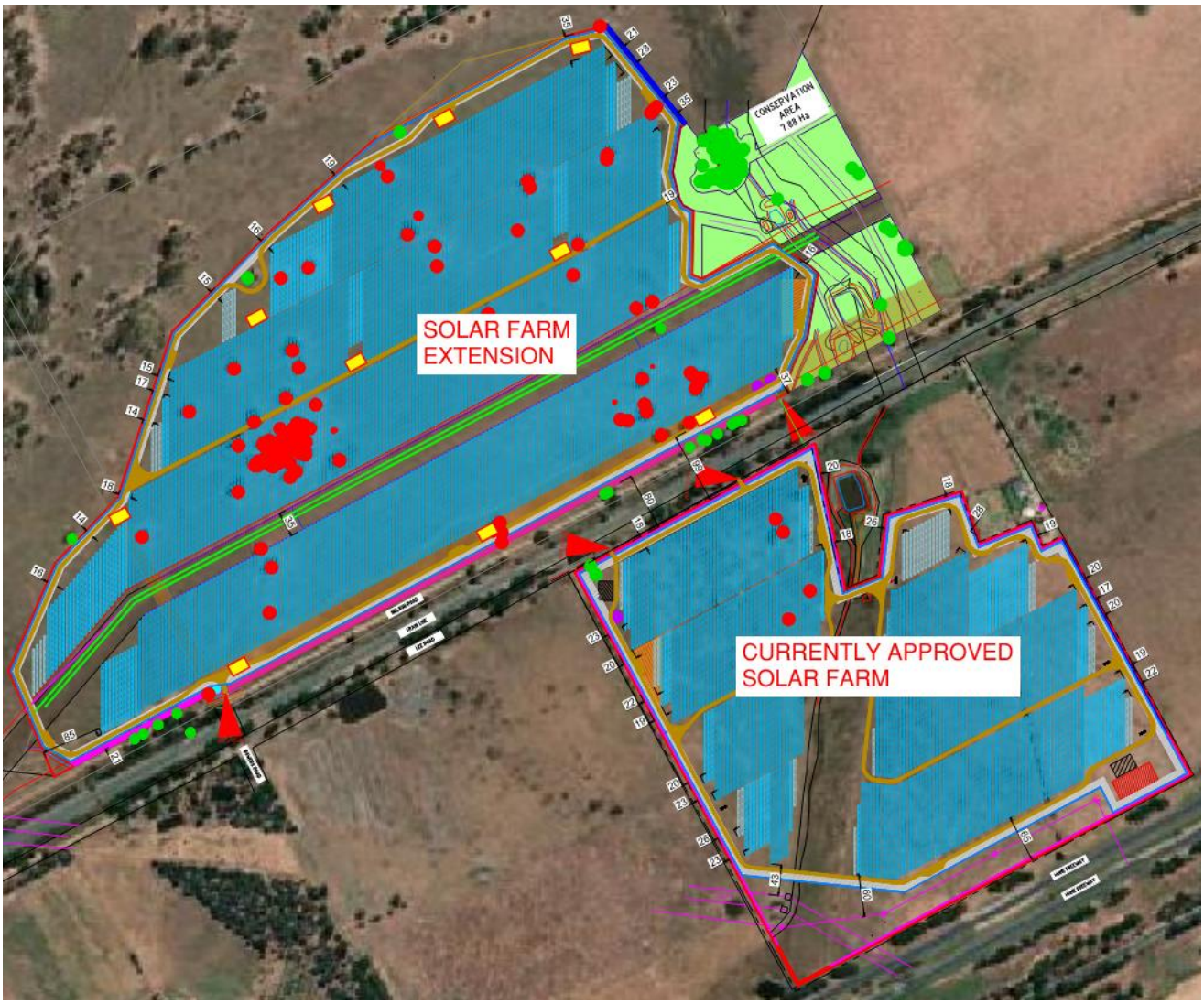

Figure 1 – Masterplan showing site context

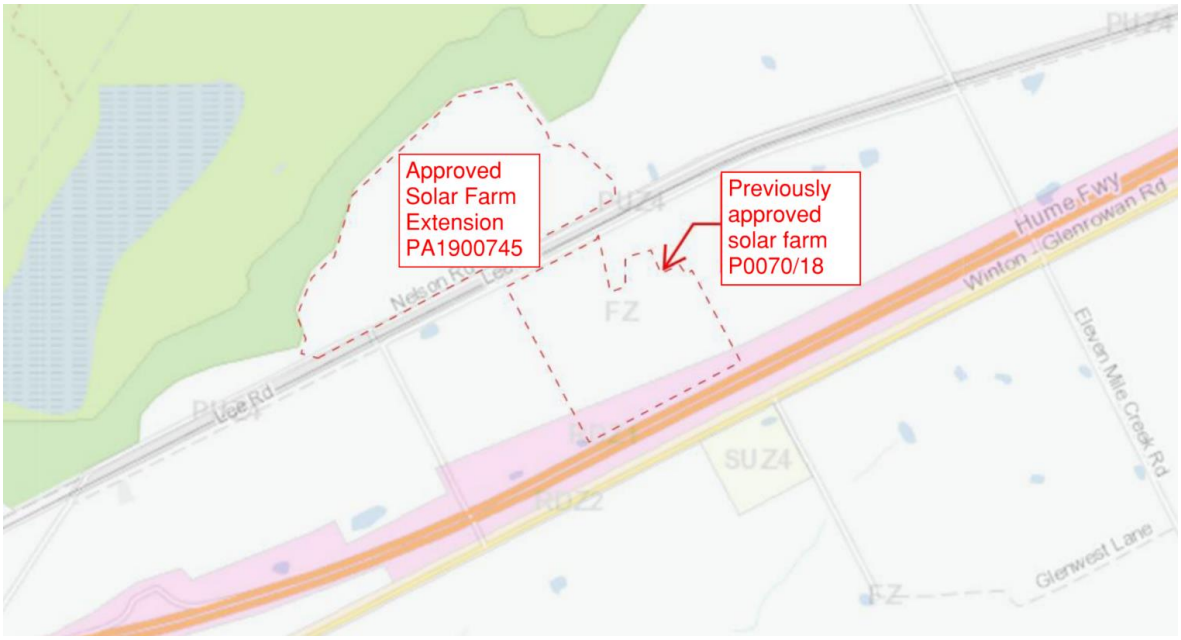

Figure 2 – Planning map showing zoning

2.2 Nearest Receivers

The three dwellings within a 1km radius of the site boundary have been analysed as part of this assessment (Figure 3). The nearest residential building is located 282m from the subject site at 116 Lee Road, Winton. Note this building is being leased as part of the project however it is located on a separate parcel of land, therefore included in the assessment. The next closest receivers are located 552m and 629m from the project boundary in Farm Zones.

Figure 3 – Nearest Residential Receivers

2.3 EPA Publication 1826.4 – Part 1: Commercial, Industrial and Trade Premises

Noise limits in rural areas for utilities are obtained by following the method set out in section 2.6 *Noise limits in rural areas for utilities* of EPA publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*:

(29) Determine the zone level and distance-adjusted level for each period using the method in clauses 19 and 20.

- *(19) Determine the zone levels for each of the day, evening and night periods using Annex B to this Noise Protocol*
- *(20) Adjust the zone levels determined under clause 19 by accounting for the distance between the zone where the noise generator is located and the location of the noise receiver in the noise sensitive area –*
    1. *if the noise generator and receiver are covered by the same contiguous zone, the distance adjustment is 0 dB;*

    […]

(30) [not applicable]

(31) If the utility is located in a Farming Zone, Rural Activity Zone or Green Wedge Zone and the distance adjustment is 0 dB, and unless a background level assessment is conducted in accordance with clauses 21 to 23, then:

a. the distance-adjusted level for each period is –

i. Day *45 dB(A)*

ii. Evening: *39 dB(A)*

iii. Night: *34 dB(A)*

(32) Where a background level assessment is conducted in accordance with clauses 21 to 23, the noise limit is determined in accordance with clause 24 and rounded to the nearest decibel.

It is apparent based on the above process that the noise limits applicable to the site are as follows:

Table 1 Noise limits applicable to receivers

Period	Noise criteria, dBA
Day (7am-6pm)	45
Evening (6pm-10pm)	39
Night (10pm-7am)	34

We understand the inverters will only operate during the day period.

3 ANALYSIS

3.1 Noise Sources

The primary noise sources within the solar farm will be the power conditioning units (PCUs), comprising:

- Freemaq PCSK FP4200K4 inverters, 96 dBA sound power level – 10x inverters, including BESS
- Eltas transformers transformers, 74 dBA sound power level – 10x transformers

This equipment will be located within the project boundaries shown in Figure 4.

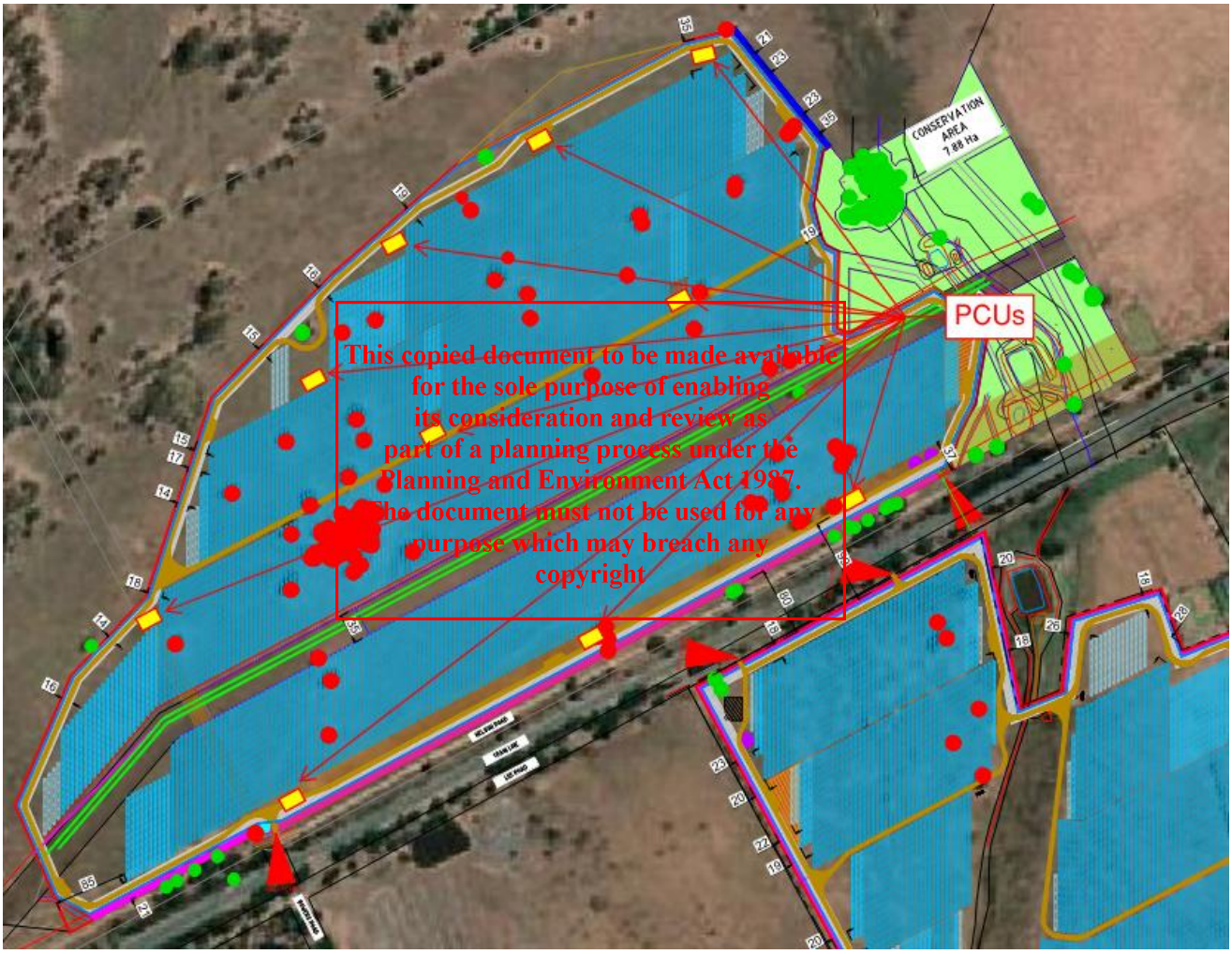

Figure 4 - Location of Noise Generating Equipment

3.2 Assessment Point

We have calculated noise levels at the three most affected receivers, as shown in Figure 5. We have assessed all dwellings within a 1km radius of the site boundary. We have labelled these as Dwelling A – 282m to subject site, Dwelling B – 552m to subject site and Dwelling C – 629m to subject site.

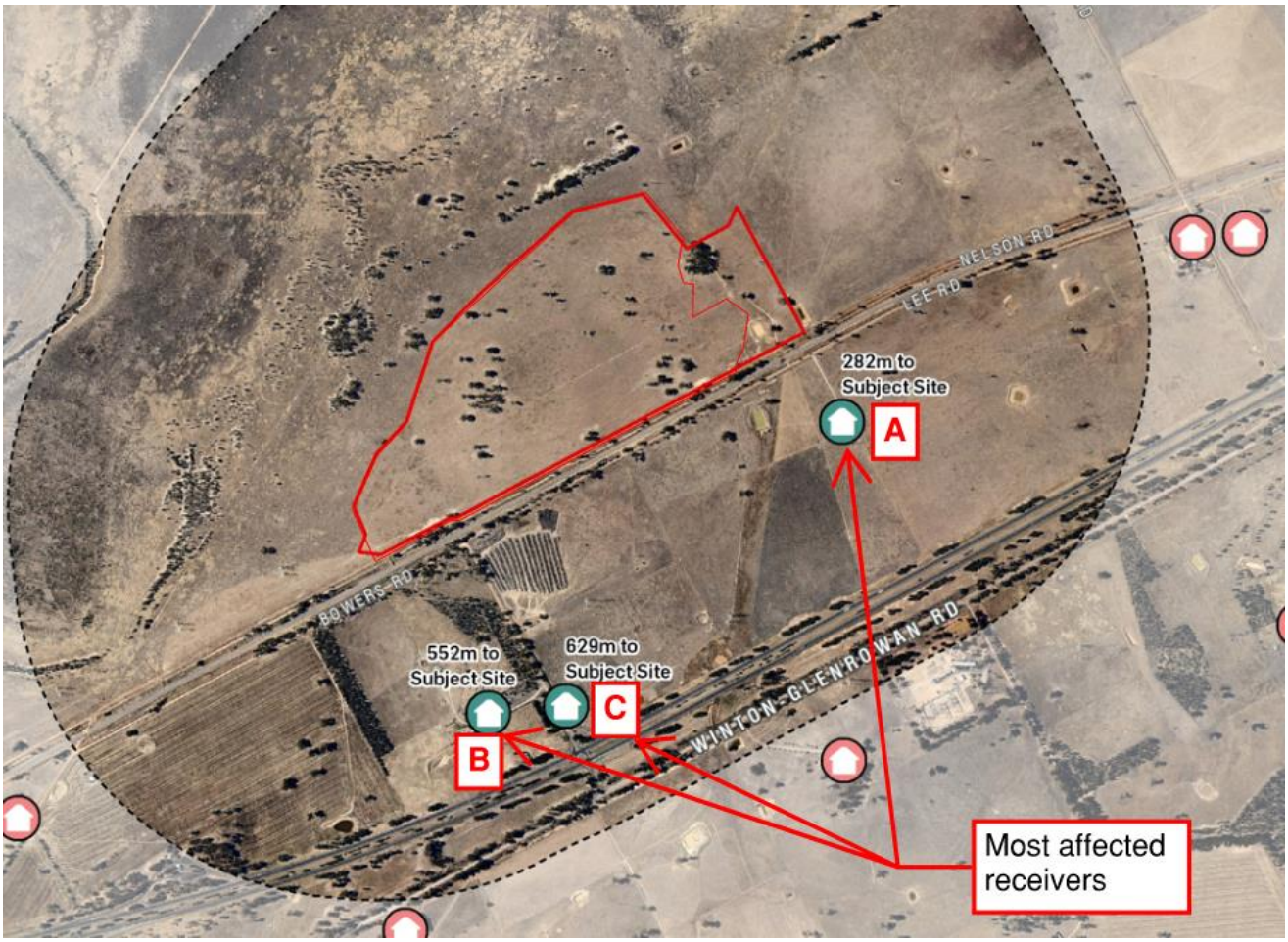

Figure 5 - Assessment Points

3.3 Noise level calculation methodology

The noise level calculation methodology is outlined as follows

1. Sound power level from the inverters was set as 96 dBA as per the technical data.
2. The distance from each inverter to each of the three dwellings was measured.
3. These distances were used to calculate the expected distance attenuation and resulting SPL at the receiver locations using the following formula (simplified):

$$SPL = SWL - 20log_{10}(r) - 8;$$

Where:

- SPL = sound level at receiver locations
- SWL = sound power level of inverter
- r = distance from inverters to receivers

4. The sound pressure levels from each of the sources were then combined to determine the cumulative noise level at the receivers. The overall noise levels were then compared against the noise level of 34dBA set in Section 2.3.

3.4 Predicted noise levels at residential receivers

The predicted noise levels at the three most affected residential receivers for each inverter are shown in Table 2. The predicted noise levels at all three dwellings comply with the relevant noise limits.

Table 2 Predicted noise levels at receivers

Receiver	Predicted Noise Level	Criteria	Comment
Dwelling A	Day - 43 dBA	Day – 45 dBA	Compliant
Dwelling B	Day - 40 dBA	Day – 45 dBA	Compliant
Dwelling C	Day - 40 dBA	Day – 45 dBA	Compliant

4 CONCLUSION

NDY has conducted a noise emission assessment to determine if the predicted noise levels from the 40 MW extension to the Mokoan Solar Farm below the EPA limits. The noise limit was determined as 45 dBA during the day period, when the solar farm operates. The noise sources analysed were inverters, with sound power level 96 dBA and transformers, with sound power level 74 dBA, contained within the PCUs. The three most affected residential receivers range between 282m and 629m from the project boundary. The combined noise level from the PUCs is predicted to be 43 dBA at the closest residential receiver and is therefore compliant with EPA limits.

APPENDIX A - TECHNICAL DATA

ELTAS
Transformatör Sanayi ve Ticaret A.Ş.

General Specifications			
Transformer type			Oil immersed, Hermetically sealed
Installation			Outdoor
Applicable standards			IEC 60076-1
Rated power	(ONAN)	*kVA*	3510
High voltage		*V*	33000
High voltage tappings (no load)		*%*	± 2 x 2,5
Low voltage (no load)		*V*	660
High voltage insulation level	(U **m** / U **AC** / U **LI**)	*kV*	36 / 70 / 170
Low voltage insulation level	(U **m** / U **AC** / U **LI**)	*kV*	1,1 / 3 / --
Frequency		*Hz*	50
Vector group			Dy11
Number of phases			3
Max. ambient temperature	For 3510 kVA	*ºC*	50
Max. temperature rise (winding / oil)		*K*	55 / 50
Max. ambient temperature	For 3630 kVA	*ºC*	40
Max. ambient temperature	For 3570 kVA	*ºC*	45
Max. altitude above sea level		*m*	1000
Permissible short circuit duration		*s*	2
X/R Ratio			10,3
Positive sequence impedance		*%*	7
Zero sequence impedance		*%*	6,3
Guaranteed Values			
Impedance voltage(75ºC)	±10 % tolerance**	*%*	7
No load losses	+0 % tolerance	*W*	3400
Load losses(75ºC)	+0 % tolerance	*W*	26000
Efficiency		*%*	99,17
Inrush Current		*pu*	<5,5
Noise level (LWA)		*dB(A)*	74
Noise level (LpA at 1 meter)		*dB(A)*	53
Structural Specifications			
High voltage winding conductor material			Al
Low voltage winding conductor material			Al
Oil type			Inhibited Mineral Transformer Oil
Paintting Code			C3H RAL 7035
Dimensions and Weight			
Length / Width / Height		*mm*	2170 / 1733 / 1966
Total weight		*kg*	7350
Weight of active part		*kg*	3900
Weight of oil		*kg*	1460
Volume of oil		*liters*	1814

Connection Terminals	
High voltage	Plug-in Bushings 36kV 400A x 3
Low voltage	Busbar Bushings 2000 A x 6

Accessories	
Hermetic Protection Relay (DMCR)	Terminal Box
Pressure Relief Device	Earthed Screen Between LV & HV (Accessible)
Off - circuit tap changer	
Lifting lugs	
Oil filling & drain valves	

* All weights and dimensions are given approximately.
** Tolerance for the impedance is according to IEC 60076-1

ELTAŞ TRANSFORMATÖR SANAYİ VE TİCARET ANONİM ŞİRKETİ
Atatürk Organize Sanayi Bölgesi 10046 Sokak No.4 35620 B. Çiğli - İZMİR - TURKEY
Tel:+90(232)3981500(Pbx) Fax :+90(232)3767764 e-mail : info@eltas.com.tr http: www.eltas.com.tr

TECHNICAL REPORT

ACOUSTIC CHARACTERIZATION
POWER ELECTRONICS INVERTER

+Technical

+Technical
C/ Luis Bolinches 18 esc 2, 1º A
46023 - VALENCIA
Teléfono: 96.320.21.11
correo@tecnival.com
www.tecnival.com

Código: C230305

INDEX

		Ck Coeff.	$\overline{L'_{p(ST)}}$	K1	$\overline{L_p}$	Lw,k
One-third octave frequency bands (Hz)	50	-30,2	73,53348		73,53348	92,90866
	63	-26,2	71,80814		71,80814	91,18332
	80	-22,5	70,93126		70,93126	90,30644
	100	-19,1	70,56472	0,16732	70,39740	89,77258
	125	-16,1	71,68304		71,68304	91,05821
	160	-13,4	72,01834		72,01834	91,39352
	200	-10,9	76,49894		76,49894	95,87412
	250	-8,6	76,88370		76,88370	96,25887
	315	-6,6	72,07875		72,07875	91,45393
	400	-4,8	67,78639	0,21558	67,57081	86,94599
	500	-3,2	68,50362	0,21680	68,28682	87,66200
	630	-1,9	66,59038	0,16567	66,42470	85,79988
	800	0,8	64,97306		64,97306	84,34824
	1k		65,57076		65,57076	84,94594
	1.25k	0,6	63,89877		63,89877	83,27395
	1.6k	1	63,08153		63,08153	82,45671
	2k	1,2	62,23450		62,23450	81,60968
	2.5k	1,3	61,37835		61,37835	80,75353
	3.15k	1,2	60,08910		60,08910	79,46428
	4k	1	59,10655		59,10655	78,48173
	5k	0,5	59,27454		59,27454	78,64972
	6.3k	-0,1	57,26557		57,26557	76,64075
	8k	-1,1	54,77045		54,77045	74,14563
	10k	-2,5	52,59152		52,59152	71,96670

Table 3. Calculation of corrected sound power levels in one-third octave bands for A-weighting.

The weighted sound power level in A-frequency is obtained as follows:

$$\boldsymbol{L_{WA} = 95,83\ dB}$$

This value is practically identical to the one obtained directly from the A-weighted sound pressure levels.

Valencia, May 10, 2023

The Industrial Engineer

Dr. Antonio Armero Martínez

Associated 2.090 COIICV

NORMAN DISNEY & YOUNG

CONSULTING ENGINEERS

NDY Management Pty Limited trading as Norman Disney & Young
ABN 29 003 234 571
115 Batman Street
West Melbourne Victoria 3003
Telephone: +61 3 9862 6800
Facsimile: +61 3 9862 6900

OFFICES

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