ARUP

File Note – Noise Verification Report

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cc	
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Subject	Noise Design Verification Report

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1. Introduction

This report certifies that the design of the Syd05, 06 and 07 Data Centre located at 757-769 Mamre Road, Kemps Creek are in accordance with the requirements outlined in "*Kemps Creek Data Centre Noise and Vibration Impact Assessment*" [1].

This acoustic certification report addresses Condition B8 of SSD-10101987. A summary of the requirements of this Design Noise Verification Report are outlined in Table 1.

Table 1: Condition B8 requirements of the Design Noise Verification Report

Requirements relevant to this Design Noise Verification Report	Where addressed in this technical report
B8. Within three months of the commencement of earthworks for the development, the Applicant must prepare and submit a Design Noise Verification Report for the development to the satisfaction of the Planning Secretary. The Applicant must not commence construction of any data centre building until the Design Noise Verification Report is approved by the Planning Secretary. The Design Noise Verification Report must:	This report
(a) be prepared by a suitably qualified, experienced and independent acoustic consultant whose appointment has been endorsed by the Planning Secretary;	Section 2 - Qualification
(b) identify and justify the design noise emission scenario, including the adopted engineering safety factor, schedule of all noise generating sources on the site, stationary equipment specification and verifiable data of dynamic noise emission activities;	Section 3 - Assessment methodology
(c) demonstrate the noise propagation modelling is capable of accurately predicting noise levels under noise enhancing meteorological conditions to surrounding receivers in Luddenham;	Section 3 - Assessment methodology
(d) provide updated noise modelling to verify the predicted performance of the development and the predicted noise levels identified in the report titled Kemps Creek Data Centre, Noise and Vibration Impact Assessment, prepared by Arup Pty Ltd, dated 1 September 2022;	Section 5 - Results

Requirements relevant to this Design Noise Verification Report	Where addressed in this technical report
(e) develop an Operational Noise Monitoring Plan in accordance with Section 7 of the Noise Policy for Industry to verify the operational performance of the development, including details of the nominated intermediate monitoring locations, reference noise levels at each intermediate location, and noise level relationship between each intermediate location and sensitive receivers identified in condition B6;	Section 6 - Operational Noise Management Plan
(f) include:	
(i) an analysis of compliance with noise limits specified in conditions B6;	Section 5 - Results
(ii) an outline of at-source and transmission path mitigation measures required to ensure compliance with the limits specified in conditions B6;	Section 3 - Assessment methodology
(iii) a description of contingency measures (including specific measures to manage noise generating activities during the night time period) in the event management actions are not effective at reducing noise levels to comply with limits specified in conditions B6.	Section 7 - Contingency measures

2. Qualification

This Design Verification Report has been prepared by Mathew Simon of Arup, a suitably qualified acoustic engineer and a member of the Association of Australian Acoustical Consultants and the Australian Acoustical Society (Member ID M1238).

3. Assessment methodology

To assess potential noise impacts during operation, two scenarios comprising typical equipment has been developed based on our understanding of the project:

- **Standard operations:** Assumes all non-emergency equipment operating throughout the day, evening and night, and one generator being tested per sub site during the daytime only. Generator testing is included as part of daytime standard (normal) operations as 62 generators need to be tested per month and that the testing duration per generator ranges from one to four hours. No testing will occur during the evening or night.
- **Critical power failure**: Assumes all emergency generators (62) operating simultaneously.

3.1 Noise sources

The primary outdoor noise sources on site are outlined in Table 2. Where equipment has yet to be selected, the sound power levels and octave band spectra have been estimated based on expected equipment power ratings and past project experience.

This list represents a preliminary list of primary equipment. Some equipment items may be redundant, may share loads, may be operating at no load, or may be switched off, thereby reducing sound power levels. This assessment therefore represents a conservative assessment scenario.

Noise emissions from all equipment is characterised as steady-state sound in accordance with AS1055:2018 [2], i.e. constant noise emissions.

Note that the emergency generators are proposed to be located within dedicated enclosures.

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Table 2: Project equipment, quantities and sound power levels (per unit)

Major Equipment and function	Description / function	Number of items on site	Overall sound power level, dBA	Octave band (Hz)							
				63	125	250	500	1k	2	4	8
				Sound power level, dB(Z)							
Generator inlet louvre - Generator used to provide power in critical power failure scenario.	Inlet of acoustic generator enclosure	62	89	101	104	87	60	58	54	61	80
Generator outlet louvre - Generator used to provide power in critical power failure scenario.	Outlet of acoustic generator enclosure	62	89	101	104	87	56	54	51	60	80
Generator exhaust - Generator used to provide power in critical power failure scenario.	Generator diesel engine exhaust.	62	89	59	64	85	81	82	84	82	76
Load Bank - Provides the electrical load representative of the datacentre operational load to allow maintenance testing of generators.	Provides the electrical load representative of the datacentre operational load to allow maintenance testing of generators.	3	111	114	111	109	105	105	104	102	95
Data Hall Transformers - Steps down power for supply to the data centre at the required voltages	3.2 MVA capacity	60	62	66	63	66	62	54	45	44	39
Site Transformers - Steps down power for supply to the data centre at the required voltages	70 MVA	3 operational, 1 idle.	80	84	81	84	80	71	62	62	57
Data hall – contains server racks and cooling fans. Noise breaking out through data hall exhaust louvres.	Level 1 exhaust louvre outlet based on internal data hall noise level of 90dBA	1 per data hall. 30 data halls	62	72	69	62	56	56	53	49	49
	Level 2 exhaust louvre outlet based on internal data hall noise level of 90dBA	1 per data hall. 30 data halls	66	72	69	64	61	61	59	55	55
Data hall – contains server racks and cooling fans. Noise breaking out through data hall roof.	Roof construction: metal deck, absorption between purlins, two layers of plasterboard	1 per data hall. 30 data halls	76	89	91	76	62	54	51	55	45

Major Equipment and function	Description / function	Number of items on site	Overall sound power level, dBA	Octave band (Hz)							
				63	125	250	500	1k	2	4	8
				Sound power level, dB(Z)							
Condensing units	Domestic type	3 Servicing admin buildings	72	76	76	73	70	66	63	60	52
AHU – supplies ventilation air to data hall	Fresh air inlets open to louvred plantrooms.	8 per data hall level, 480 overall	63	81	75	66	53	46	44	34	40

3.2 Maintenance testing criteria

Maintenance testing of emergency plant is anticipated to occur during daytime period (7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and Public Holidays. between 7am and 6pm). The total testing regime for all 62 generators is summarised in Table 3.

Table 3: Annual testing regime

Month	Test	Duration (min)		Colo gen testing		Admin gen testing		Total Gens Tested	Total Mins
		Run	Cooldown	Number of tests	Gens run per test[1]	Number of tests	Gens run per test[1]		
1	**Bi-monthly, no load**	**10**	**0**	**30**	**2**	**2**	**1**	**62**	**320**
2	No test							62	0
3	Quarterly, 70% load	30	5	60	1	2	1	62	2170
4	**Bi-monthly, no load**	**10**	**0**	**30**	**2**	**2**	**1**	**62**	**320**
5	No test							62	0
6	Quarterly, 70% load	30	5	60	1	2	1	62	2170
7	**Bi-monthly, no load**	**10**	**0**	**30**	**2**	**2**	**1**	**62**	**320**
8	No test							62	0
9	Quarterly, 70% load	30	5	60	1	2	1	62	2170
10	**Bi-monthly, no load**	**10**	**0**	**30**	**2**	**2**	**1**	**62**	**320**
11	No test							62	0
12	Annual, 100% load	60	5	60	1	2	1	62	4030
								Total minutes per year	**11820**
								Total hours per year	**197**

Note:

Rows in **BOLD** indicate a potential worst case scenario regarding noise emissions which have been assessed.

1. Colo generator testing will be conducted separately from admin generator testing.

This equates to 197 hours of testing per year.

Two potential worst case scenarios including generator testing have been identified:

- Bi-monthly no load – two colo generators being tested concurrently with no load applied, i.e. no load bank operating; and
- Annual 100% load – single colo generator being tested with 100% load applied, i.e. load bank operating.

These two scenarios have been included in the assessed scenarios.

Quarterly testing noise emissions are expected to generate noise emissions lower than annual testing, based on the same operating scenario but with the load bank only be operating at 70% load.

Note that generator testing has been included as part of standard operations considering that 62 generators need to be tested per month and that testing duration for all generators annually would be 197 hours per year.

3.3 Operating Scenarios

Operating scenarios assessed are outlined in Table 4. The scenarios are considered representative of the noisiest operational activities likely to occur. In practice, mechanical systems will vary in load dependant on internal and external temperatures, therefore, operation is expected to be typically lower than assessed.

Table 4: Modelling scenarios and corresponding plant and equipment

Project equipment	Model scenarios			
	1A. Standard Operation – Daytime, bi-monthly generator testing[1]	1B. Standard Operation – Daytime, annual generator testing[1]	2. Standard Operation – Evening and night	3. Critical power failure – 24 hours
	Number of equipment modelled in 15-minute assessment period.			
Generator inlet louvre	1	2	-	62
Generator outlet louvre	1	2	-	62
Generator exhaust	1	2	-	62
Load Bank	1	-	-	-
Data Hall Transformers	60	60	60	60
Site Transformers	3	3	3	3
Level 1 data hall exhaust	30	30	30	30
Level 2 data hall exhaust	30	30	30	30
Data hall roof	30	30	30	30
AHU fresh air inlet	480	480	480	480

3.4 Noise modelling assumptions

Noise emissions have been modelled using SoundPlan 8 using the CONCAWE algorithm with a 3m/s source to receiver wind applied representing worst case meteorological conditions which is considered appropriate for this scenario with nearest receivers located further than 100 metres of the noise sources.

The model included:

- Activity noise sources listed in Section 3.1;
- On-site and surrounding buildings;
- Receivers;
- Ground terrain and absorption; and
- A safety factor of 2dB to account for modelling tolerance within the noise model.

4. Operational Noise Limits

Operational noise limits are presented in Condition B6 of the Consent Conditions, reproduced below:

B6. The Applicant must ensure that noise generated by operation of the development does not exceed the noise limits in Table 2.

Table 2 Noise Limits (dB(A))

Location	***Day $L_{Aeq(15\ min)}$***	***Evening $L_{Aeq(15\ min)}$***	***Night $L_{Aeq(15\ min)}$***
Residential receivers near Medinah Avenue (Luddenham)	*37*	*32*	*28*
Residences within the MRP	*48*	*40*	*38*

Note Noise generated by the development is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW Noise Policy for Industry (EPA, 2017) (as may be updated or replaced from time to time). Refer to the plan in Appendix 3 for the location of residential sensitive receivers.

B7. The Applicant must ensure the operation of plant and equipment does not generate intermittent noise at receiver locations identified in Table 2 in accordance with Fact Sheet C of the NSW Noise Policy for Industry (EPA, 2017).

5. Results

Noise emissions as predicted in the updated noise modelling are presented in Table 5.

Table 5: predicted noise emissions, $L_{Aeq(15min)}$ dBA

Receiver	1A. Day			1B. Day			2. Evening			3. Night		
	Noise limit	Predicted Noise level	Complies	Noise limit	Predicted Noise level	Complies	Noise limit	Predicted Noise level	Complies	Noise limit	Predicted Noise level	Complies
R1 - 771-781 Mamre Road Kemps Creek	48	40	Yes	48	38	Yes	40	36	Yes	38	36	Yes
R2 - 783-797 Mamre Road Kemps Creek	48	40	Yes	48	39	Yes	40	37	Yes	38	37	Yes
R3 - 799-803 Mamre Road Kemps Creek	48	40	Yes	48	40	Yes	40	38	Yes	38	38	Yes
R4 - 15 Medinah Avenue Luddenham	37	29	Yes	37	29	Yes	32	28	Yes	28	28	Yes
R5 - 9 Medinah Avenue Luddenham	37	29	Yes	37	29	Yes	32	28	Yes	28	28	Yes
R6 - 676-702 Mamre Road Kemps Creek	48	30	Yes	48	26	Yes	40	26	Yes	38	26	Yes
R7 - 676-702 Mamre Road Kemps Creek	48	32	Yes	48	27	Yes	40	27	Yes	38	27	Yes

Predicted noise emissions comply with noise limits at all locations in all periods.

An assessment of modifying factor corrections has been conducted in accordance with Fact Sheet C of the NPfI [3]. No intermittent, tonal or low-frequency penalties are incurred when cumulative site noise emissions and measured ambient noise spectra are assessed.

6. Operational Noise Management Plan

Commissioning tests shall be undertaken at the two measurement locations shown in Figure 1. These locations are representative of the worst affected residential receivers. Compliance at these locations would demonstrate compliance at all residences.

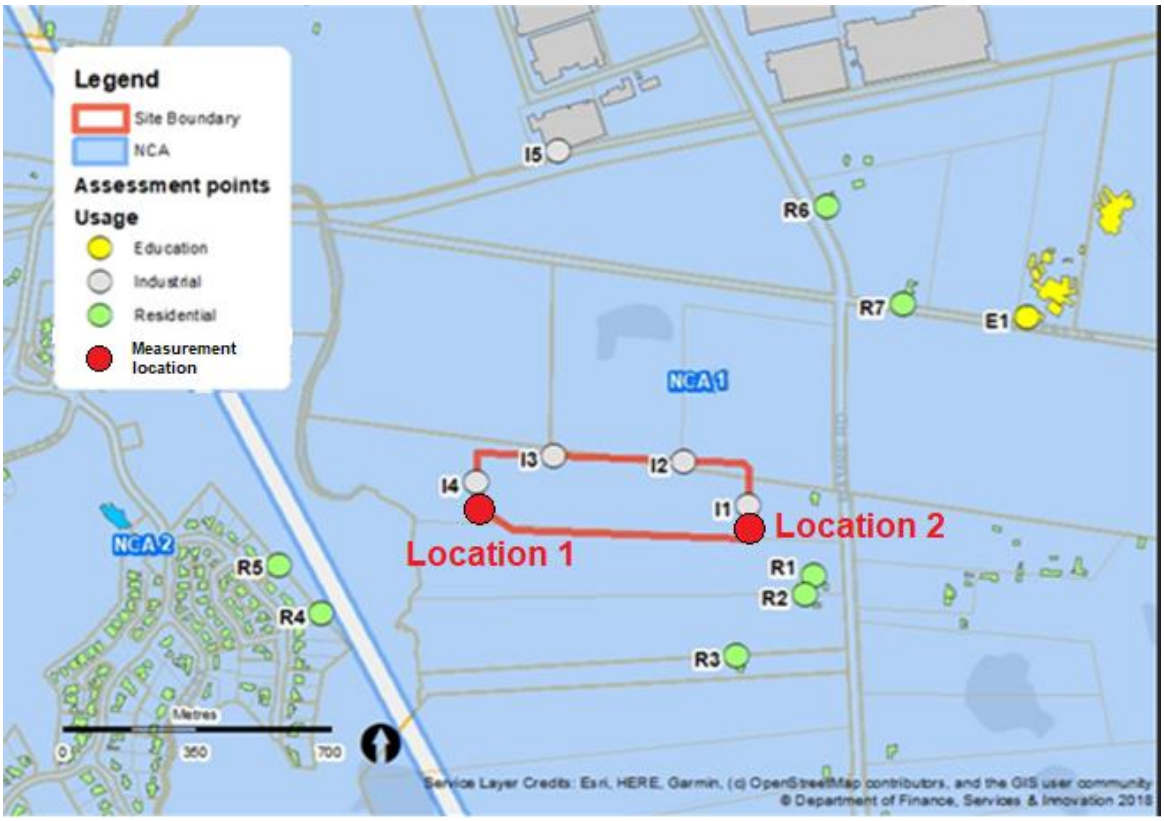

Figure 1: Representative noise monitoring locations

Representative noise limits of

- L_{Aeq} 36 dBA at location 1
- L_{Aeq} 50 dBA at location 2

shall be assessed against, which correlate to a compliant noise level at the worst affected receivers based on the updated noise model.

Measurements shall be taken in accordance with Section 7 of the EPA's Noise Policy for Industry [3]. Measurements shall be conducted in accordance with AS 1055.1: Australian Standard 1055.1 – 1997 Acoustics – Description and measurement of environmental noise – General procedures. All meters shall comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated Class 1 suitable for field use.

In order to determine the contribution from the site, a background noise measurement shall be subtracted from the level at the monitoring location.

If contribution measurements at representative locations are not able to be used to determine site contributions, near field measurements of one operational item of plant representing each significant noise generating source identified in Table 2 shall be undertaken at an accessible location but near enough that the contribution from that plant item is dominant (i.e. 10 dB above ambient noise level). These levels shall be used to calculate the sound power of each plant type and

compared to those listed in Table 2. Noise levels which are no higher than those listed would demonstrate compliance.

7. Contingency measures

This section provides a summary of the management measures which may be considered for key plant items if residual exceedances remain post construction.

Table 6: Summary of pre-mitigation and residual impacts

Contingency measure	Applicable plant
Retrofit enclosures around roof top equipment	Condensers
Additional absorptive lining to louvred AHU plantroom	AHU plantroom
Barriers around site transformers	Site transformers

8. References

[1] Arup, “Kemps Creek Data Centre - Noise and Vibration Impact,” Arup, Sydney, 2022.

[2] Standards Australia, “AS 1055 Acoustics—Description and measurement of environmental noise,” Standards Australia, Sydney, 2018.

[3] NSW Environment Protection Authority, “NSW Noise Policy for Industry,” NSW Environment Protection Authority , Sydney, 2017.