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# MOREE BATTERY ENERGY STORAGE SYSTEM

## Construction & Operational Noise & Vibration Assessment

28 June 2024

NGH Consulting

TN563-01F02 Construction & Operational Noise & Vibration Assessment (r4).docx

40 YEARS 1982-2022 ACOUSTIC ENGINEERING EXCELLENCE

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# Contents



## List of Tables

## List of Figures

# 1 Introduction

Renzo Tonin & Associates was engaged to conduct an environmental noise and vibration assessment for the proposed Moree Battery Energy Storage System (BESS) Project, located within the Moree Plains Local Government Area (LGA) in New South Wales (NSW), as part of the Environmental Impact Statement (EIS) for the project. Noise and vibration impacts from the construction and operation phases of the project are addressed in this report in accordance with relevant Council and NSW Environment Protection Authority's (EPA) requirements and guidelines.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

# 2 Project Description

## 2.1 Background Information

'AE BESS 2 Pty Ltd as Trustee for AE BESS 2 Unit Trust' (the proponent) intends to develop a 120MW/480MWh lithium-ion Battery Energy Storage System (BESS) at Bulluss Drive, Moree. The BESS would connect to the national electricity market (NEM) via TransGrid's 132kV Moree Bulk Supply Point substation, located immediately to the north of the development site (leased developable area). The connection would be via underground transmission line to a new 132kV connection bay at the substation.

The subject land (the full area of all involved lots) comprises Lot 82 DP 751780 and part of Lot 144 DP751780, which totals 17.58 hectares (ha) of privately-owned land. The area to be developed would comprise approximately 4.06 ha.

The proposed development sits within the Moree Special Activation Precinct (SAP), located in the far north of NSW and known for its productive soils. In December 2019, the Moree SAP was announced, followed by the adoption of the Master Plan and Delivery Plan in 2022. The Moree SAP currently comprises mostly of industrial and agri-industrial development.

The subject land is currently undeveloped and is devoid of stands of remnant vegetation. An existing borrow pit turned farm dam is present in the north-western portion. As indicated above, the subject land is adjacent to the Moree Bulk Supply Point substation and fronts Bulluss Drive.

The key elements of the proposed development would include:

- Approximately 125 x 20ft battery containers, containing lithium-ion technology.
- Approximately 50 associated 20ft skid-mounted Power Conversion Systems (PCS) comprising of the inverters, which convert direct current (DC) to alternating current (AC); the medium-voltage transformer, which converts the inverter output voltage to the medium-voltage of the system (33 kilovolt); and the medium voltage switchgear, which contains the medium voltage circuit breakers and disconnectors for the PCS.
- A 33 kilovolt (kV) switch room, which collects all the individual medium voltage cables from the PCS units in one location before connection to the high-voltage transformer. The auxiliary power is also supplied from the low-voltage room that is connected to the medium-voltage switch room.
- A control room, which will contain battery-monitoring equipment and allows operators to control the plant remotely.
- A short overhead or underground transmission line which connects the proposed BESS to the adjacent Moree substation. The connection type is subject to Transgrid requirements.

## 2.2 Regulatory Requirements

Noise and vibration impacts are assessed in accordance with a number of policies, guidelines and standards, including:

- NSW 'Interim Construction Noise Guideline' (ICNG – DECC, 2009)
- NSW 'Noise Policy for Industry' (NPfI – EPA, 2017)
- 'Assessing Vibration: A Technical Guideline' (DECC, 2006)
- NSW 'Road Noise Policy' (RNP – DECCW, 2011).

This assessment generally conforms with the requirements of the Moree Special Activation Precinct – Delivery Plan (SAP – Regional Growth NSW Development Corporation, 2022) in particular the noise requirements in Section 6.3.3.3. It is noted that the 'SAP Assessment Framework – NOISE' was available at the time of this assessment, however acceptable solutions for noise nominated in the SAP also draw from the NPfI which is considered in this assessment.

## 2.3 Receiver Locations

The nearest affected receivers were identified through aerial maps and are presented in Table 2-1.

**Table 2-1 – Receiver Locations**

| ID | Address | Description |
|---|---|---|
| R1 | Tycannah Street, Moree (DP1117043) | Industrial property located approximately 120 m southwest of the subject site |
| R2 | Bulluss Drive, Moree (DP999486) | Industrial property located approximately 70 m north of the subject site |
| R3 | 2 Bulluss Drive, Moree | Industrial property located approximately 210 m north of the subject site. It is noted that a dwelling is located at this address but as the property is zoned industrial, the dwelling also adopts the same criteria as industrial usage. |
| R4 | 10 Bulluss Drive, Moree | Industrial property located approximately 210 m north of the subject site |
| R5 | 10 Industrial Drive, Moree (DP607739) | Industrial property located approximately 245 m south of the subject site |
| R6 | 89 Tycannah Street, Moree | Industrial property located approximately 250 m west of the subject site |
| R7 | 37 Bulluss Drive, Moree | Industrial property located approximately 270 m northeast of the subject site |
| R9 | 10 Industrial Drive, Moree (DP635190) | Industrial property located approximately 325 m southeast of the subject site |
| R15 | 75 Tycannah Street, Moree | Industrial property located approximately 330 m northeast of the subject site |
| R18 | 4 Amaroo Drive, Moree (Gwydir Thermal Pools Motel & Caravan Park) | Residential property located approximately 380 m west of the subject site |
| R21 | 40-52 Industrial Drive, Moree | Industrial property located approximately 395 m southeast of the subject site |

Figure 1 provides details of the site, surrounds and receiver locations.

## 2.4 Hours of Operation

### 2.4.1 Construction

Construction will occur during the following standard hours of construction:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm
- No work on Sundays or public holidays

### 2.4.2 Operation

There will be staff on site during the following operational hours:

- Monday to Friday: 9:00am to 5:00pm

**Figure 2-1 – Site, Surrounds and Receiver Locations**

# 3 Existing Noise Environment

Background noise varies over the course of any 24 hour period, typically from a minimum at 3am in the morning to a maximum during morning and afternoon traffic peak hours. Therefore, the NPfI requires that the level of background and ambient noise be assessed separately for the daytime, evening and night-time periods. The NPfI defines these periods as follows:

- **Day** is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays.
- **Evening** is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.
- **Night** is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays.

The identified receivers surrounding the subject site are all classified as rural under NPfI guidelines. Based on Table 2.1 on page 10 of the NPfI, for a conservative assessment the minimum assumed Rating Background Levels (RBLs) are adopted instead for all receiver locations. Therefore, the applicable RBLs use for this assessment are presented in Table 3-1 below.

**Table 3-1 – Applicable RBL, dB(A)**

| Time of Day | Minimum RBLs, dB(A)[1] | Applicable RBL, dB(A) |
|---|---|---|
| Day | 35 | **35** |
| Evening | 30 | **30** |
| Night | 30 | **30** |

Notes: 1. In accordance with Table 2.1 of the NSW NPfI

# 4 Construction Noise Assessment

## 4.1 Construction Noise Management Levels

The NSW 'Interim Construction Noise Guideline' (ICNG, 2009) provides guidance for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

- *Use of $L_{Aeq}$ as the descriptor for* measuring *and assessing construction noise*

  NSW noise policies, including the NPfI, RNP and RING have moved to the primary use of $L_{Aeq}$ over any other descriptor. As an energy average, $L_{Aeq}$ provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the $L_{A10}$ descriptor.

- *Application of reasonable and feasible noise mitigation measures*

  As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice and is practical to build given the project constraints.

  Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria. A qualitative assessment is recommended for small projects with duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

Given the length of the construction works proposed is approximately nine (9) months, a quantitative assessment is carried out herein, consistent with the ICNG requirements.

Table 4-1 reproduced from the ICNG, sets out the noise management levels and how they are to be applied for residential receivers.

**Table 4-1 – Noise Management Levels (NML) at Residential Receivers, dB(A)**

| Time of Day | Management Level $L_{Aeq\ (15\ min)}$ | How to Apply |
|---|---|---|
| Recommended standard hours:<br>Monday to Friday<br>7 am to 6 pm<br>Saturday 8 am to 1 pm<br>No work on Sundays or public holidays | Noise affected<br>RBL + 10dB(A) | The noise affected level represents the point above which there may be some community reaction to noise.<br>Where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details. |
| | Highly noise affected<br>75dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:<br>• times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences)<br>• if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |
| Outside recommended standard hours | Noise affected<br>RBL + 5dB(A) | A strong justification would typically be required for works outside the recommended standard hours.<br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.<br>For guidance on negotiating agreements see section 7.2.2 of the ICNG. |

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Table 4-2 presents the construction noise management levels established for the nearest noise sensitive residential receivers based upon the nominated RBLs presented in Table 2-1, the proposed construction hours and the above ICNG requirements. Given that construction works are to occur during the daytime period as presented in Section 2.4.1, only the daytime period will be assessed.

**Table 4-2 – Construction Noise Management Levels (NML) at Residential Receivers, dB(A)**

| Location Description | Day $L_{A90}$ Background Noise Level (RBL) | Day Noise Management Level $L_{Aeq(15min)}$ |
|---|---|---|
| All residential receivers | 35[1] | **45** |

Notes: 1. Construction works occur during the daytime period only; hence, only the day period is assessed

Table 4-3 sets out the ICNG noise management levels for other noise sensitive receiver locations. As identified for residential receivers, a 'highly affected' noise objective of $L_{Aeq(15min)}$ 75dB(A) is adopted for all noise sensitive receivers, with exceedances addressed as described in Table 4-1.

**Table 4-3 – Noise management levels at other noise sensitive land uses**

| Land use | Where objective applies | Management level $L_{Aeq\ (15\ min)}$ |
|---|---|---|
| Industrial premises | External noise level | 75 dB(A) |

Notes: 1. Noise management levels apply when receiver areas are in use only.

## 4.2 Construction Noise Sources

The following tables lists typical plant and equipment likely to be used by the contractor to carry out the necessary construction works for the BESS project.

**Table 4-4 – Typical Construction Equipment & Sound Power Levels, dB(A) re. 1pW**

| Plant Item | Plant Description | $L_{Aeq}$ Sound Power Levels, dB(A) re. 1pW (single item) |
|---|---|---|
| 1 | Crane | 110 |
| 2 | Drum roller | 109 |
| 3 | Padfoot roller | 109 |
| 4 | Wheeled loader | 109 |
| 5 | Dump truck | 108 |
| 6 | 30t Excavator | 107 |
| 7 | Grader | 107 |
| 8 | Chain trencher | 104 |
| 9 | Water truck | 104 |
| 10 | Telehandler | 98 |
| 11 | Forklift | 90 |

The sound power levels for the majority of activities presented in the above table are provided by the client, based on maximum levels given in Table A1 of Australian Standard 2436 - 2010 'Guide to Noise Control on Construction, Demolition and Maintenance Sites', the ICNG, information from past projects and/or information held in our library files.

## 4.3 Construction Noise Assessment

Noise emissions were predicted by modelling the noise sources, receiver locations, topographical features of the intervening area, and possible noise control treatments using the CadnaA (version 2023) noise modelling computer program. The program calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site.

The noise prediction models takes into account:

- Location of noise sources and receiver locations;
- Height of sources and receivers;
- Separation distances between sources and receivers;

- Ground type between sources and receivers (soft); and
- Attenuation from barriers (natural and purpose built).

Noise levels at any receptors resulting from construction would depend on the above and the type and duration of construction being undertaken. Furthermore, noise levels at receivers would vary substantially over the total construction program due to the transient nature and large range of plant and equipment that could be used.

Table 4.4 presents construction noise levels likely to be experienced at the nearby affected receivers based on the construction activities and plant and equipment associated with the proposed development site. It is noted that the predicted noise levels represent a worst case scenario where all plant and equipment are operating for each corresponding construction stage. This worst case scenario would not be typical and is unlikely to occur in practice.

The noise level ranges presented in the table represent the noise source being located at the furthest to the closest proximity to each receiver location.

**Table 4-5 – Predicted $L_{Aeq,15min}$ Construction Noise Levels at Receiver Locations, dB(A)**

| Plant Item | Plant Description | Predicted $L_{eq,15\ min}$ Construction Noise Levels | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R9 | R15 | R18 | R21 |
| *Noise Management Level*[1] | | *75* | *75* | *75* | *75* | *75* | *75* | *75* | *75* | *75* | *45* | *75* |
| 1 | Crane | <20-51 | <20-50 | <20-46 | <20-45 | <20-44 | <20-44 | <20-43 | <20-41 | <20-40 | <20-40 | <20-40 |
| 2 | Drum roller | <20-50 | <20-49 | <20-45 | <20-44 | <20-43 | <20-43 | <20-42 | <20-40 | <20-39 | <20-39 | <20-39 |
| 3 | Padfoot roller | <20-50 | <20-49 | <20-45 | <20-44 | <20-43 | <20-43 | <20-42 | <20-40 | <20-39 | <20-39 | <20-39 |
| 4 | Wheeled loader | <20-50 | <20-49 | <20-45 | <20-44 | <20-43 | <20-43 | <20-42 | <20-40 | <20-39 | <20-39 | <20-39 |
| 5 | Dump truck | <20-49 | <20-48 | <20-44 | <20-43 | <20-42 | <20-42 | <20-41 | <20-39 | <20-38 | <20-38 | <20-38 |
| 6 | 30t Excavator | <20-48 | <20-47 | <20-43 | <20-42 | <20-41 | <20-41 | <20-40 | <20-38 | <20-37 | <20-37 | <20-37 |
| 7 | Grader | <20-48 | <20-47 | <20-43 | <20-42 | <20-41 | <20-41 | <20-40 | <20-38 | <20-37 | <20-37 | <20-37 |
| 8 | Chain trencher | <20-45 | <20-44 | <20-40 | <20-39 | <20-38 | <20-38 | <20-37 | <20-35 | <20-34 | <20-34 | <20-34 |
| 9 | Water truck | <20-45 | <20-44 | <20-40 | <20-39 | <20-38 | <20-38 | <20-37 | <20-35 | <20-34 | <20-34 | <20-34 |
| 10 | Telehandler | <20-39 | <20-38 | <20-34 | <20-33 | <20-32 | <20-32 | <20-31 | <20-29 | <20-28 | <20-28 | <20-28 |
| 11 | Forklift | <20-31 | <20-30 | <20-26 | <20-25 | <20-24 | <20-24 | <20-23 | <20-21 | <20-20 | <20-20 | <20-20 |
| **Up to 3 (noisiest) plant operating concurrently** | | <20-55 | <20-54 | <20-50 | <20-49 | <20-48 | <20-48 | <20-47 | <20-45 | <20-44 | <20-44 | <20-44 |

Table 4-5 indicates that the predicted construction noise levels comply with the construction noise management levels for all receiver locations. Therefore no further mitigation and/or management measures are required for construction noise.

# 5 Operational Noise Assessment

## 5.1 Operational Noise Criteria

Noise impact from the general operation of the Proposal is assessed against the NSW 'Noise Policy for Industry' (NPfI). The assessment procedure in terms of the NPfI has two components:

- Controlling intrusive noise impacts in the short-term for residences; and
- Maintaining noise level amenity for residences and other land uses.

In accordance with the NPfI, noise impact should be assessed against the project noise trigger level which is the lower value of the project intrusiveness noise levels and project amenity noise levels.

### 5.1.1 Intrusive Noise Impacts

According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the $L_{Aeq,15min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

**$L_{Aeq,15minute}$ Intrusiveness noise level = Rating Background Level (RBL) plus 5dB(A)**

Based on the RBLs set in Table 3-1, the intrusiveness noise levels for the residential receivers are determined in Table 5-1.

**Table 5-1 – NPfI Intrusive Noise Level at Residential Receivers, dB(A)**

| Period | RBL, dB(A) | Intrusiveness Noise Level, $L_{Aeq,15min}$, dB(A) |
|---|---|---|
| Daytime | 35 | 35+5 = **40** |
| Evening | 30 | 30+5 = **35** |
| Night-time | 30 | 30+5 = **35** |

### 5.1.2 Protecting Noise Amenity

The project amenity noise levels for different time periods of a day are determined in accordance with Section 2.4 of the NSW NPfI. The NPfI recommends amenity noise levels ($L_{Aeq, period}$) for various receivers including residential, commercial, industrial receivers and sensitive receivers such as schools, hotels, hospitals, churches and parks. These "recommended amenity noise levels" represent the objective for **total** industrial noise experienced at a receiver location. However, when assessing a **single** industrial development and its impact on an area, "project amenity noise levels" apply.

The recommended amenity noise levels applicable for the subject area are reproduced in Table 5-2 below.

It is noted that the residential receivers in the vicinity of the site have been categorised as being in a 'rural' area in accordance with Table 2.3 of the NPfI.

**Table 5-2 – Amenity noise levels (Table 2.2 NPfI)**

| Receiver | Noise Amenity Area | Time of Day | $L_{Aeq}$, dB(A) |
|---|---|---|---|
| (see Table 2.3 to determine which residential receiver category applies) | | | Recommended amenity noise level, |
| Residential | Rural | Day | 50 |
| | | Evening | 45 |
| | | Night | 40 |
| Industrial premises | All | When in use | 70 |

To ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for an area, the project amenity noise level that applies for each new industrial noise source is determined as follows:

$$L_{Aeq,period}\ \text{Project amenity noise level} = L_{Aeq,period}\ \text{Recommended amenity noise level} - 5\text{dB(A)}$$

Furthermore, given that the intrusiveness noise level is based on a 15 minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPfI provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15minute}$ level in order to standardise the time periods.

$$L_{Aeq,15min} = L_{Aeq,period} + 3\text{dB(A)}$$

The policy, in accordance with the NPfI, applies an adjustment of (+3 dB) to the recommended noise levels ($L_{Aeq,\ period}$) in order to standardise the time periods for the intrusiveness and amenity noise levels. The project amenity noise levels ($L_{Aeq,\ 15min}$) applied for this project are reproduced in Table 5-3.

**Table 5-3 – NPfI Project Amenity Noise Levels, dB(A)**

| Type of Receiver | Indicative Noise Amenity Area | Time of Day | Recommended Noise Level | |
|---|---|---|---|---|
| | | | $L_{Aeq,\ Period}$ | $L_{Aeq,\ 15min}$ |
| Residence | Rural | Day | 50 – 5 = 45 | 45 + 3 = **48** |
| | | Evening | 45 – 5 = 40 | 40 + 3 = **43** |
| | | Night | 40 – 5 = 35 | 35 + 3 = **38** |
| Industrial | All | When in use | 70 – 5 = 65 | 65 + 3 = **68** |

Notes: 1. The $L_{Aeq}$ index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

### 5.1.3 Summary of Project Noise Trigger Levels

In accordance with the NPfI the project noise trigger level, which is the lower (i.e. more stringent) value of the project intrusiveness noise level and project amenity noise level, has been determined and reproduced in Table 5-4 below.

**Table 5-4 – Project Noise Trigger Levels, dB(A)**

| Receiver ID | Address | $L_{Aeq, 15min}$ Project Noise Trigger Levels | | |
|---|---|---|---|---|
| | | Day | Evening | Night |
| R1 | Tycannah Street, Moree (DP1117043) | | 68 (When in use) | |
| R2 | Bulluss Drive, Moree (DP999486) | | 68 (When in use) | |
| R3 | 2 Bulluss Drive, Moree | | 68 (When in use) | |
| R4 | 10 Bulluss Drive, Moree | | 68 (When in use) | |
| R5 | 10 Industrial Drive, Moree (DP607739) | | 68 (When in use) | |
| R6 | 89 Tycannah Street, Moree | | 68 (When in use) | |
| R7 | 37 Bulluss Drive, Moree | | 68 (When in use) | |
| R9 | 10 Industrial Drive, Moree (DP635190) | | 68 (When in use) | |
| R15 | 75 Tycannah Street, Moree | | 68 (When in use) | |
| R18 | 4 Amaroo Drive, Moree (Gwydir Thermal Pools Motel & Caravan Park) | 40 | 35 | 35 |
| R21 | 40-52 Industrial Drive, Moree | | 68 (When in use) | |

## 5.2 Operational Noise Sources

The following table lists associated plant and equipment likely to be used for the operation of the proposed BESS and their corresponding sound power levels.

**Table 5-5 – Typical Operational Plant and Equipment & Sound Power Levels**

| Plant Item | Plant Description | $L_{Aeq}$ Sound Power Levels, dB(A) re. 1pW |
|---|---|---|
| 1 | Battery containers (140 in total) | 79 (each) |
| 2 | Power Conversion Systems (42 in total) | 84 (each) |
| 3 | HV transformer (1 in total) | 95 (each) |

The sound power levels for the plant and equipment presented in the above table have been provided by the manufacturer, information from past projects and/or information held in our library files. The plant and equipment included are all packaged units and all sound power levels include the noise component from associated fans/cooling systems.

## 5.3 'Modifying Factor' Adjustments

Further to the above and in accordance with the NPfI, where the character of the noise in question is assessed as particularly annoying (i.e. if it has an inherently tonal, low frequency, impulsive or

intermittent characteristic), then an adjustment of 5dB(A) for each annoyance aspect, up to a total of 10dB(A), is to be added to the predicted value to penalise the noise for its potential increase in annoyance. Table C1 in Fact Sheet C of the NSW NPfI provides definitive procedures for determining whether a penalty or adjustment should be applied from increased annoyance.

For the assessment of the Proposal, the noise from the power conversion systems are considered to be tonal in nature. Therefore, a 5dB(A) penalty has been applied to the predicted noise contributions from the power conversion systems as noted in Table 5.4.

## 5.4 Operational Noise Assessment

Noise emissions were predicted by modelling the noise sources, receiver locations, topographical features of the intervening area, and possible noise control treatments using the CadnaA (version 2023) noise modelling computer program. The program calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site.

The noise prediction models takes into account:

- Location of noise sources and receiver locations;
- Height of sources and receivers;
- Separation distances between sources and receivers;
- Ground type between sources and receivers (soft); and
- Attenuation from barriers (natural and purpose built).

Furthermore, in accordance with Fact Sheet D, Table D.1 of the NPfI noise predictions were prepared for the following standard and noise-enhancing meteorological conditions:

1. Standard meteorological conditions – 0.5m/s wind velocity at 10m from ground level between each noise source and each noise receiver. Wind direction was based on wind travelling from the source to the receiver
2. Slight to gentle breeze – 3m/s wind velocity at 10m from ground level between each noise source and each noise receiver (as per NPfI default wind conditions). Wind direction was based on wind travelling from the source to the receiver
3. Moderate temperature inversion – applicable for noise predictions during night time periods only. F-class temperature inversion with 2m/s wind velocity at 10m from ground level between each noise source and each noise receiver

Table 5.5 below present the predicted noise levels for the worst case scenario based on concurrent operation of all the plant and equipment shown in Table 5-5.

**Table 5-6 – Predicted $L_{Aeq,15min}$ Operational Noise Levels at Sensitive Receiver Locations, dB(A)**

| Receiver Location | Project Noise Trigger Levels | | | Predicted Operational Noise Levels | | | Comply? (Yes/No) |
|---|---|---|---|---|---|---|---|
| | Day | Evening | Night | Calm & Isothermal Conditions | Slight to Gentle Breeze | Moderate Temperature Inversion[1] | |
| Receiver R1 | | *68 (When in use)* | | 40 | 41 | 41 | Yes |
| Receiver R2 | | *68 (When in use)* | | 43 | 44 | 44 | Yes |
| Receiver R3 | | *68 (When in use)* | | 39 | 40 | 40 | Yes |
| Receiver R4 | | *68 (When in use)* | | 37 | 39 | 39 | Yes |
| Receiver R5 | | *68 (When in use)* | | 40 | 41 | 41 | Yes |
| Receiver R6 | | *68 (When in use)* | | 34 | 36 | 36 | Yes |
| Receiver R7 | | *68 (When in use)* | | 33 | 35 | 35 | Yes |
| Receiver R9 | | *68 (When in use)* | | 37 | 39 | 39 | Yes |
| Receiver R15 | | *68 (When in use)* | | 32 | 33 | 33 | Yes |
| Receiver R18 | *40* | *35* | 35 | 35 | 35 | 35 | Yes |
| Receiver R21 | | *68 (When in use)* | | 35 | 37 | 37 | Yes |

Notes: 1. Applicable for the night time period only

Table 5.5 indicates that the predicted operational noise levels comply with the project noise trigger levels for all time periods for all receiver locations. Therefore no further mitigation and/or management measures are required for operational noise.

## 5.5 Sleep Disturbance Assessment

To assess the likelihood of sleep disturbance, the potential of maximum noise level events from the Proposal during the night-time period has been considered. In accordance with the NPfI, a detailed maximum noise level event assessment should be undertaken where the subject development night-time noise levels at a residential location exceed:

- $L_{Aeq,15min}$ 40dB(A) or the prevailing RBL plus 5dB, whichever is the greater, and/or
- $L_{AFmax}$ 52dB(A) or the prevailing RBL plus 15dB, whichever is the greater.

Where there are noise events found to exceed the initial screening level, further analysis is undertaken to identify:

- The likely number of events that might occur during the night assessment period,
- The extent to which the maximum noise level exceeds the rating background noise level.

Based on the NPfI and the RBL for the night time period as presented in Table 3-1, the sleep disturbance assessment noise levels for the residential receivers are presented in Table 5-7.

**Table 5-7 – Sleep disturbance assessment noise levels, dB(A)**

| Receiver type | Assessment Level $L_{Aeq,15min}$ | Assessment Level $L_{AFmax}$ |
|---|---|---|
| Residential | **40** | **52** |

During the night time period, only mechanical plant will be operating. Noise emissions from these plant items are considered to be continuous with no potential for high peak noise level events. Therefore, the $L_{Amax}$ noise levels experienced at the identified receivers will be similar to the predicted $L_{Aeq,15min}$ noise levels shown in Table 5.5. Hence, it is expected that both the $L_{Aeq,15min}$ and $L_{AFmax}$ will be well below the nominated sleep disturbance criteria of 40dB(A) and 52dB(A), respectively, for all residential receiver locations.

# 6 Vibration Assessment

Vibration generating activities would occur only during the construction phase of the project. There are no vibration generating activities expected during the operational phase. Assessment for construction vibration impact on structural damage and human comfort is assessed in accordance with EPA requirements.

## 6.1 Vibration Criteria

Assessment of potential disturbance from vibration on human occupants of buildings is made in accordance with the EPA's *'Assessing Vibration; a technical guideline'* (DECC, 2006). The guideline provides criteria which are based on British Standard BS 6472-1992 *'Evaluation of human exposure to vibration in buildings (1-80Hz)'*. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent'. Table 6-1 provides definitions and examples of each type of vibration.

**Table 6-1 – Types of Vibration**

| Type of Vibration | Definition | Examples |
|---|---|---|
| Continuous vibration | Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time) | Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery). |
| Impulsive vibration | A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds | Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. |
| Intermittent vibration | Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude | Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers.<br>Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria. |

Source: Assessing Vibration; a technical guideline, Department of Environment & Climate Change, 2006

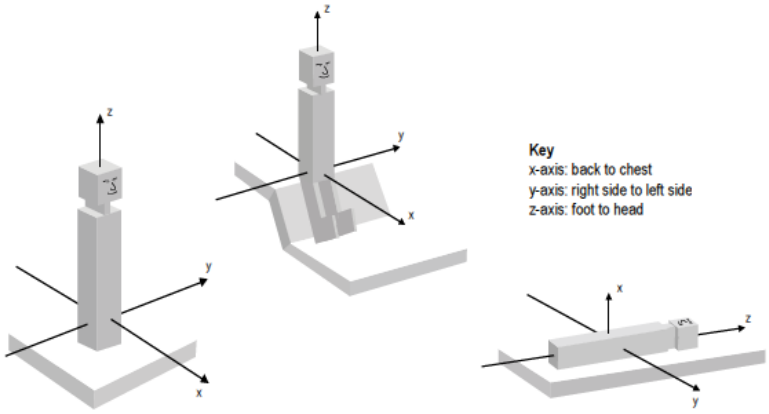
The vibration criteria are defined as a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

> *"Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472)."*

When applying the criteria, it is important to note that the three directional axes are referenced to the human body, i.e. x-axis (back to chest), y-axis (right side to left side) or z-axis (foot to head). Vibration may enter the body along different orthogonal axes and affect it in different ways. Therefore, application of the criteria requires consideration of the position of the people being assessed, as

illustrated in Figure 6-1. For example, vibration measured in the horizontal plane is compared with x- and y-axis criteria if the concern is for people in an upright position, or with the y- and z- axis criteria if the concern is for people in the lateral position.

**Figure 6-1 – Orthogonal Axes for Human Exposure to Vibration**




The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced in Table 6-2 for the applicable receivers.

**Table 6-2 – Preferred and Maximum Levels for Human Comfort**

| Location | Assessment Period[1] | Preferred Values | | Maximum Values | |
|---|---|---|---|---|---|
| | | z-axis | x- and y-axis | z-axis | x- and y-axis |
| **Continuous vibration (weighted RMS acceleration, $m/s^2$, 1-80Hz)** | | | | | |
| Residences | Daytime | 0.010 | 0.0071 | 0.020 | 0.014 |
| | Night-time | 0.007 | 0.005 | 0.014 | 0.010 |
| Workshops | Day- or night-time | 0.04 | 0.029 | 0.080 | 0.058 |
| **Impulsive vibration (weighted RMS acceleration, $m/s^2$, 1-80Hz)** | | | | | |
| Residences | Daytime | 0.30 | 0.21 | 0.60 | 0.42 |
| | Night-time | 0.10 | 0.071 | 0.20 | 0.14 |
| Workshops | Day- or night-time | 0.64 | 0.46 | 1.28 | 0.92 |

Notes: 1. Daytime is 7:00am to 10:00pm and Night-time is 10:00pm to 7:00am

The acceptable vibration dose values (VDV) for intermittent vibration are defined in Table 2.4 of the guideline and are reproduced in Table 6-3 for the applicable receiver type.

**Table 6-3 – Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)**

| Location | Daytime[1] | | Night-time[1] | |
|---|---|---|---|---|
| | Preferred Value | Maximum Value | Preferred Value | Maximum Value |
| Residences | 0.20 | 0.40 | 0.13 | 0.26 |
| Workshops | 0.80 | 1.60 | 0.80 | 1.60 |

Notes: 1. Daytime is 7:00am to 10:00pm and Night-time is 10:00pm to 7:00am

## 6.2 Potential Vibration Impacts

Based on the proposed plant items presented in Table 4-4, vibration generated by construction plant was estimated and potential vibration impacts are summarised in Table 6-4 below. The assessment is relevant to the identified receiver locations.

**Table 6-4 – Potential Vibration Impacts for Identified Receivers**

| Receiver Location | Approx. Distance to Nearest Buildings from Works | Type of Nearest Sensitive Buildings | Assessment on Potential Vibration Impacts | Vibration Monitoring |
|---|---|---|---|---|
| Receiver R1 | 120m | Industrial | Very low risk of structural damage and/or adverse comments | Not required |
| Receiver R2 | 70m | Industrial | Very low risk of structural damage and/or adverse comments | Not required |
| Receiver R3 | 210m | Industrial | Very low risk of structural damage and/or adverse comments | Not required |
| Receiver R4 | 210m | Industrial | Very low risk of structural damage and/or adverse comments | Not required |
| Receiver R5 | 245m | Industrial | Very low risk of structural damage and/or adverse comments | Not required |
| Receiver R6 | 250m | Industrial | Very low risk of structural damage and/or adverse comments | Not required |
| Receiver R7 | 270m | Industrial | Very low risk of structural damage and/or adverse comments | Not required |
| Receiver R9 | 325m | Industrial | Very low risk of structural damage and/or adverse comments | Not required |
| Receiver R15 | 330m | Industrial | Very low risk of structural damage and/or adverse comments | Not required |
| Receiver R18 | 380m | Residential | Very low risk of structural damage and/or adverse comments | Not required |
| Receiver R21 | 395m | Industrial | Very low risk of structural damage and/or adverse comments | Not required |

Table 6.4 indicates that there is very low risk of structural damage and/or adverse comments on potential vibration impacts for all receiver locations. Therefore no further mitigation and/or management measures are required for potential vibration impacts.

# 7 Road Traffic Noise Assessment

Noise impact from the potential increase in traffic on the surrounding road network due to construction and operational activities is assessed against the NSW 'Road Noise Policy' (RNP). The RNP sets out criteria to be applied to particular types of road and land uses. These noise criteria are to be applied when assessing noise impact and determining mitigation measures for sensitive receivers that are potentially affected by road traffic noise associated with the construction and operation of the subject site, with the aim of preserving the amenity appropriate to the land use.

Based on information provided by the client, the peak vehicle movements during the construction stage of the project are presented in the following table. Furthermore, vehicle movements will only occur during the day time period when construction works occur.

**Table 7-1 – Summary of the Estimated Construction Traffic Volumes During Peak Construction**

| Vehicle Type | Vehicle Movements (two-way) | |
|---|---|---|
| | Daily | Peak hour |
| Light Vehicle (car / 4WD) | 10 | 5 |
| Shuttle Bus | 2 | 1 |
| MRV/HRV | 40 | 10 |
| AV / B-Double | 60 | 20 |
| **Total** | **112** | **36** |

During the operational stage, vehicle access to the site will be maintenance vans or delivery trucks which would occur on an irregular basis. Traffic noise impacts during the operational stage of the project would be minimal and insignificant and will not be assessed further.

## 7.1 Road Traffic Noise Criteria

Access to the will be from Bulluss Drive and Narrabri Road which are classified as an arterial road. For existing residences affected by additional traffic on existing arterial roads generated by land use developments, the following RNP road traffic noise criteria would apply.

**Table 7-2 – RNP Road Traffic Noise Criteria, dB(A)**

| Road Category | Type of Project/Land Use | Assessment Criteria, dB(A) | |
|---|---|---|---|
| | | Day 7am – 10pm | Night 10pm – 7am |
| Freeway/arterial/sub-arterial roads | 3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments | $L_{Aeq,(15\ hour)}$ 60 (external) | $L_{Aeq,(9\ hour)}$ 55 (external) |

As construction works are to occur only during the day time period, only the traffic noise criteria for the day period are assessed against.

Further to the above, the RNP states the following for land use developments generating additional traffic:

> *"For existing residences and other sensitive land uses affected by **additional traffic on existing roads generated by land use development**, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'."*

## 7.2 Predicted Road Traffic Noise

Results of the road traffic noise predictions are presented in the table below. It is noted that the predicted noise levels represent the traffic noise contribution from the vehicle movements associated with the construction works and does not take into account traffic noise levels due to existing general traffic flows as existing traffic volumes along Bulluss Drive are unknown.

**Table 7-3 – Predicted Road Traffic Noise Contribution Levels Along Public Roads, dB(A)**

| Receiver | Criteria | Traffic Movements | Speed (km/h)[1] | Distance to Road[2] | Predicted Noise Level | Exceed? |
|---|---|---|---|---|---|---|
| Residences on Bulluss Drive and Narrabri Road | $L_{Aeq,\ (15\ hour)}$ 60 | As per Table 7.1 | 60/80 | 20m | 52 | No |

Notes: 1. Based on posted speed limit
2. Based on closest typical distance from facade of dwelling to the road

From the above table, it can be seen that road traffic noise level contributions from the vehicle movements associated with the construction works are within the applicable noise criteria based on dwellings being at the closest typical distance from the roads.

Furthermore, as the predicted levels are at least 2dB(A) less than the relevant traffic noise criterion, it is not expected that the traffic noise contribution from the construction vehicles would result in an exceedance of the traffic noise criterion and/or increase the existing traffic noise levels by more than 2dB(A).

Therefore, traffic noise levels as a result of the construction works for the project would not adversely contribute to the existing traffic noise levels at the most affected residences along the surrounding roads.

# 8 Conclusion

Renzo Tonin and Associates has completed an environmental noise and vibration assessment of the proposed Moree Battery Energy Storage System project.

Noise emissions from the construction and operational phases of the project were predicted to comply with the nominated criteria at all existing nearest affected receivers.

Given the large separation distance between most of the affected receivers and the subject site, vibration impacts resulting in structural damage to buildings at the nearest affected receivers are determined to be negligible and there is a very low risk of adverse comments from occupants of sensitive receivers due to construction vibration.

Road traffic noise impacts due to additional traffic generated during the construction phase of the project on residential properties along the access route were found to comply with the relevant RNP criteria. Road traffic noise impacts from traffic associated with the operation of the project were considered to be negligible due to the minimal traffic movements.

# APPENDIX A Glossary of Terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

| | |
|---|---|
| Adverse weather | Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter). |
| Ambient noise | The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far. |
| Assessment period | The period in a day over which assessments are made. |
| Assessment point | A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated. |
| Background noise | Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below). |
| Decibel [dB] | The units that sound is measured in. The following are examples of the decibel readings of every day sounds:<br>0dB The faintest sound we can hear<br>30dB A quiet library or in a quiet location in the country<br>45dB Typical office space. Ambience in the city at night<br>60dB CBD mall at lunch time<br>70dB The sound of a car passing on the street<br>80dB Loud music played at home<br>90dB The sound of a truck passing on the street<br>100dB The sound of a rock band<br>110dB Operating a chainsaw or jackhammer<br>120dB Deafening |
| dB(A) | A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. |
| dB(C) | C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies. |
| Frequency | Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz. |
| Impulsive noise | Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise. |
| Intermittent noise | The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more. |
| $L_{Max}$ | The maximum sound pressure level measured over a given period. |
| $L_{Min}$ | The minimum sound pressure level measured over a given period. |

| | |
|---|---|
| $L_1$ | The sound pressure level that is exceeded for 1% of the time for which the given sound is measured. |
| $L_{10}$ | The sound pressure level that is exceeded for 10% of the time for which the given sound is measured. |
| $L_{90}$ | The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A). |
| $L_{eq}$ | The "equivalent noise level" is the summation of noise events and integrated over a selected period of time. |
| Reflection | Sound wave changed in direction of propagation due to a solid object obscuring its path. |
| SEL | Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations. |
| Sound | A fluctuation of air pressure which is propagated as a wave through air. |
| Sound absorption | The ability of a material to absorb sound energy through its conversion into thermal energy. |
| Sound level meter | An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels. |
| Sound pressure level | The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone. |
| Sound power level | Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power. |
| Tonal noise | Containing a prominent frequency and characterised by a definite pitch. |