GROUND VIBRATION AND AIR OVERPRESSURE ASSESSMENT

Wallerawang Power Station, Wallerawang NSW 2845

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Executive Summary

A Blast monitoring programme was carried out on behalf of Liberty Industrial (client) at Wallerawang Power Station, Wallerawang NSW 2845. The monitoring was conducted during the demolition by explosive blasting.

Blast monitoring included ground vibration assessment and airblast overpressure assessment. The monitoring was conducted by Mr Faz Jalali, Senior Consultant. Measurements were carried out on the 23 February 2022 for demolition blasting main building remaining.

Monitors were placed at five receptors:

1. 1 Duncan Street, Lidsdale
2. United Petrol Pump
3. 121 Main Street, Wallerawang
4. 55 Cripps Avenue, Wallerawang
5. Transgrid Electrical Stanchion Footing

Following completion of blast works, the level of AirBlast Overpressure (Sound) was found to be below the predicted levels, except for the United Petrol Station at 136.9 dB (Human comfort levels set at 115dB, structural damage 133dB). The Ground Vibration levels were found to be below the predicted and recommended control levels for Human Comfort and Structural Damage (Residential and industrial).

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Abbreviations/Definition

Air Blast Overpressure	The sudden increase in air pressure, generated by shock wave, produced when an explosion is detonated
AS	Australian Standard
dB	Decibel
EPA	Environmental Protection Agency
Ground Vibration	Mechanical energy (Vibration) produced by a blast and transmitted through the ground
Human Comfort	Levels of ground and/or airblast that do not cause discomfort to humans
Hz	Hertz
L_{Aeq}	Sound Pressure Level in dB, equivalent to the total Sound Energy over a given period
Lp	Sound Pressure Level
NATA	National Australian Testing Authority
Peak Particle Velocity (PPV)	The peak level of particle velocity calculated from the vector formed by the magnitude of the tree orthogonal components of particular velocity over their measured time history
Peak Sound Pressure Level (dBL)	The maximum value reached by the sound pressure. There is no time-constant applied and is the true Peak of the sound pressure wave.
SLM	Sound Level Meter
Sound pressure level (dB)	The logarithmic scale of pressure with a reference pressure of 20 µPa

1. Introduction

A Blast monitoring programme was carried out on behalf of Liberty Industrial (client) at Wallerawang Power Station, Wallerawang NSW 2845. The monitoring was conducted during the demolition of the main building by explosive blasting.

Blast monitoring included ground vibration assessment and airblast overpressure assessment. The monitoring was conducted by Mr Faz Jalali, Senior Consultant. Measurements were carried out 23 February 2022.

Two criteria were monitored:

1. Ground vibration: It is the mechanical radiation of energy through rock mass or soil. Typically, the magnitude of ground vibration together with frequency are used to define damage criteria.
2. Airblast Pressure: It is the pressure wave (Sound) produced as a result of blasting, transmitted through the air, consisting of various peaks with a range of frequencies. It is important to recognise that air blast maybe reflected by layers within the atmosphere and the airblast may be refocused at distance away from the blast. Airblast generally causes more complaints than ground vibration as given its logarithmic nature an increase of 6 dB represents a doubling of the sound pressure levels.

1.1 Predicted levels

Prior to commencement of demolition works, a report had been commissioned by the client to estimate (predict) the levels of vibration and airblast, based on the distance of the receptors and the amount of explosives to be used. The predicted levels as mentioned by Aurocon Ltd, as per report 180926 the guidelines provide recommended maximum levels and blast overpressure and ground vibration to maintain the amenity of residents. Further details on blast safety and criteria are provided in Australian Standard 2187.2-2006 Explosive – Storage, Transport. Where Blasting is required the guidelines are:

- maximum blast overpressure: 115 dB(L)
- maximum peak particle vibration velocity: 5 millimetres per second.

These targets should be met for all but 5% of blasts, and in no case should the blast overpressure exceed 120 dB(L) or peak particle velocity exceed 10 millimetres per second. The guidelines also provide a long-term goal of 2 millimetres per second for peak particle vibration velocity.

1.2 Adopted Limitation

Limitation for vibration and airblast pressure has been adopted at per AS2187.2 - Explosive Storage and Use, where limitation has been defined for prevention of structural damage cause by blasting and human comfort in relation to blasting activities. They are as follows:

Table 1 Adopted Limitations for Human Comfort

Building Type	Peak Component Velocity in Frequency (PPV)	Peak Sound Pressure Level (dBL)
Re-enforced light framed structure. Residential and light commercial building	5mm/s	115 dBL

Table 2 Adopted Limitations for Damage Control

Building Type	Peak Component Velocity in Frequency (PPV)	Peak Sound Pressure Level (dBL)
Re-enforced light framed structure. Residential and light commercial building	15mm/s at 4 Hz. Increasing to 20mm/s at 15 Hz	133 dBL

2. Procedure

Measurement of noise and vibration levels was carried out at the five locations (nearest receptors). These locations were as follows:

Figure 1 Depicts Receptor Locations

2.1 Methodology

- Times selected for measurements were as follows:
  - 23rd of February 2022, Demolition blast at 10:30am
- The monitors were set up approximately 1 hour prior to blast event and 30 minutes after the event.
- Monitors were set up at least 1 meter away from walls and the vibration sensor pad was pinned into ground surface.
- Instruments were calibrated prior to commencement of monitoring.
- Weather conditions were noted at the time of monitoring
- Any audible tonal and impulsive characteristics of the noise were noted.
- Monitors were recalibrated to ensure that variation is not significantly varied to ensure the result's validity.

Figure 2 Depicts Monitoring in Progress at Location 5

Figure 3 Depicts Monitoring in Location 3

Figure 4 Depicts Monitoring Location 1

Figure 5 Depicts Monitoring in Progress at Location 2

3. Results

The following summarises the peak results during Demolition blast events.

Table 3 Monitoring Measurements from Test Blast

Date	Time	Location	Peak Airblast Pressure Level	Peak Component Velocity in Frequency (PPV)	Weather condition	Compliance with adopted limits
			dBL	mm/s		
23-02-22	10:30	1 Duncan Street, Lidsdale	97.9	1.19	Raining, cloudy, SSW wind	Comply
23-02-22	10:30	United Petrol pump	**136.9**	2.35	Raining, cloudy, SSW wind	Non-Comply
23-02-22	10:30	121 Main Street, Wallerawang	47.68	0.142	Raining, cloudy, SSW wind	Comply
23-02-22	10:30	55 Cripps Avenue, Wallerawang	41.0	0.344	Raining, cloudy, SSW wind	Comply
23-02-22	10:30	Transgrid Electrical Stanchion Footing	-	1.18	Raining, cloudy, SSW wind	Comply

4. Discussions and Recommendations

Following completion of blast demolition, the measured airblast pressure at the United Petrol Pump location was found to be above adopted limit for human comfort and structural damage at 136.9 dB Peak Airblast Pressure Level. All other airblast pressures measured were within tolerance levels.

Vibration levels were significantly below control limits for structural damage and human comfort. In dealing with sensitive historical buildings, typically, ground vibration levels expressed in terms of peak particle velocity (PPV) have been set at 5 mm/s, based on a clause in AS 2187.2—1993, but not in AS 2187.2—2006. More stringent control levels are applied by The German DIN Standard "The Structural Vibration, Part 3: Effects of Vibration on Structures (DIN 4150-3)". It requires 3mm/sec PPV.

Note that all vibration levels recorded during the blast demolition works were below 3.0mm/sec PPV.